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# Color Workflows

- ## **Best Practices: Archival Aspect Ratio Workflow**

Many films and series, particularly documentaries, often incorporate archival footage as part of their storytelling process. The GEM platform does not impose creative limitations on aspect ratios; however, any technical issues must be addressed before final delivery. This resource offers guidance on recognizing and correcting aspect ratio discrepancies in archival material during post-production.

In some cases, filmmakers may have clear knowledge of their archival footage's source format. When the original format is known, its aspect ratio should correspond to that of the digitized version used. For instance, footage shot on Super 8mm typically has a 4:3 aspect ratio—if your digitized file matches this ratio, you can trust that the original proportions have been preserved through digitization.

Conversely, if the original format is unknown or the footage has undergone multiple conversions before reaching you, accurately determining the correct aspect ratio can be difficult. Archival files downloaded from websites or received from private collections may have unintentional distortions due to previous processing errors.

Due to these challenges, archival-heavy projects rarely have complete, reliable information about the original media format. To prevent distorted, stretched, or skewed archival footage in GEM productions, this guide helps creators and partners develop a clear and effective plan for working with archival assets to deliver the highest quality results.

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## Editorial Best Practices:

- When the original source is unavailable, assume that the current footage may have aspect ratio inaccuracies.

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- Verify your footage's resolution and Pixel Aspect Ratio (PAR), noting that some older formats use non-square PAR values (e.g., NTSC at 0.9 PAR, HDCAM at 1.3 PAR).
- Rely on visual judgment—if a clip looks off to you, it is likely problematic for your audience as well.
- Seek alternate versions of archival footage, especially for well-known events.
- Review your entire project closely at final stages to catch any archival aspect ratio errors.
- If edges of archival footage fluctuate, standardize the appearance using mattes, masks, or blanking for uniformity (refer to visual examples).
- Experiment with slight squeezing or stretching of clips to detect hidden distortions.
- Watch for distorted text or familiar objects—these visual clues often reveal aspect ratio problems.
- When encountering suspect footage from archival sources, contact the archive for clarification or better files.
- Report irregularities to your Post Supervisor promptly.
- Even subtle aspect ratio fixes are valuable and improve overall quality.

## Roles and Responsibilities:

- The Post Supervisor holds final responsibility for ensuring aspect ratio issues are corrected before delivery.

- Assistant and Offline Editors should identify and fix errors during the editing workflow, ensuring framing is consistent before passing projects to finishing.
- Online Editors, Colorists, and creative staff should notify supervisors when spotting potential aspect ratio problems.

- QC Operators may flag issues but should not be solely relied upon to catch nuanced discrepancies, as some situations may be intentional creative choices.

- If uncertain about aspect ratio correctness, reach out to GEM's post-production management or technology teams for guidance.

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## Visual Correction Examples:

- **Example 1:** Correcting footage compressed ("squashed") horizontally.
- **Example 2:** Adjusting footage that is stretched vertically.
- **Example 3:** Fixing footage with irregular or varied edge lines using creative mattes or zoom approaches to maintain visual consistency across varying formats.

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## Delivery Best Practices with Multiple Aspect Ratios:

- When grading projects in DolbyVision that contain multiple aspect ratios, set the L0 metadata based on the largest aspect ratio in use. Adjust L5 metadata dynamically for other shots. Avoid lift level adjustments greater than 0.025 on letterboxed or pillarboxed shots.

- Multiple aspect ratios within an IMF package can affect playback on different devices. Encodes are based on the largest active picture area, potentially adding letterboxing or pillarboxing when mixing ratios.

- For example, a project primarily in 2:1 (3840x1920) containing some 4:3 (2880x2160) archival footage will encode at UHD 3840x2160, with 2:1 shots letterboxed and 4:3 shots pillarboxed accordingly.

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- ## **Working Resolution: Considerations & Best Practices**

## Introduction

This article explores the concept of working resolution and shares best practices for image scaling throughout the production process. While not mandatory for GEM productions, choosing and documenting a working resolution is a powerful way to eliminate confusion between teams, enable efficient workflows, avoid scaling artifacts, and simplify final delivery and archival tasks. GEM is available to assist in evaluating production-specific workflows with all key stakeholders. For a broader overview, see the [Framing & Working Resolution Calculator: User Guide].

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## What Does Working Resolution Do?

Even on single-camera projects, teams may use multiple file resolutions or aspect ratios. The resolution of your Original Camera Files (OCF) often differs from how images are framed or from deliverables. VFX might request extra area for stabilization or tracking, and delivery resolutions can differ from the final active image.

All these variations make scaling workflows more complex after capture, including editorial, review files, and archiving.

Defining a working resolution unifies all scaling needs into a single container, allowing just one image scaling step between camera footage and delivery. This minimizes the risk of scaling mistakes and inconsistencies during post. With a set working resolution, everyone knows how to process the image pipeline—dailies teams have a clear

deliverable, editorial sees only the intended image, final color works from a consistent timeline, and VFX departments always know what appears on screen.

Working resolution is both a project-specific number and a shared approach for teams. Start planning during pre-production for best results.

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## Start With the Framing Chart

Before finalizing a working resolution, review the framing chart for your main camera and define all relevant image areas. For more info, see [Framing Charts Best Practices].

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## Example A: OCF Matches Delivery

A project shooting Panasonic Varicam Pure in UHD mode for a 1.78:1 outcome matches the delivery resolution in the OCF. No scaling or cropping is necessary; OCF and working resolution are identical.

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## Example B: Safety Area

If a project shoots in 4K DCI sensor mode for 2.00:1 and frames for a UHD crop within the OCF, a ~6% safety area is included. Delivery involves center-cropping to 3840 width and letterboxing. The working resolution should include both active image and the safety area: 4096 x 2160.

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## Example C: Added Safety Margin

Shooting ARRI Alexa LF Open Gate for a 2.00:1 aspect ratio and a 5% safety margin, with a final deliverable of UHD IMF (3840x2160):

- Red line: Full OCF captured image

- Yellow: Minimum image with safety margin
- Blue: Active image area (on screen)
- Cyan: Delivery container (IMF 1.78:1)

Calculate working resolution width:

- Width: IMF width / (1 - safety margin)
- For 5%, 3840 / 0.95 ≈ 4044
- Height: working width / OCF aspect ratio (nearest even pixel count)

Apply a center crop and you get your active image in the IMF container.

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## Minimum Working Resolution

Sometimes, including all extra image area is inefficient. Use the minimum working resolution by cropping tighter while keeping a small safety margin for repositioning and stabilization.

Calculate width as before; for height, limit to the safety crop:

- Height: IMF height / (1 - safety margin)
- Example: 1920 / 0.95 ≈ 2022

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## Special Cases

## Secondary Cameras

Use your primary camera framing to establish working resolution, even if secondary cameras differ in source image size. The active image deliverable stays constant; different resolutions will fit into the predetermined scaling approach.

## Multiple Primary Formats

Some productions use more than one primary capture mode—find a common working resolution that accommodates all formats. Consult GEM for guidance in these cases.

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## Anamorphic Capture

For anamorphic lenses, calculate using desqueezed dimensions. Start with height if the aspect ratio is wider; for narrower aspect ratios, begin with width. Formulas should account for squeeze factors.

Example:

- Height: IMF height / (1 - safety percent)
- Width: height × OCF aspect ratio × squeeze factor

Tools like the [Framing & Working Resolution Calculator] and [Anamorphic Minimum Capture Resolution Calculator] are available to simplify these calculations.

## VFX Needs

If VFX requires more data than the working resolution provides, use the original OCF to supply plates at full source resolution.

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GEM's team is here to advise production-specific workflow decisions—reach out to GEM contacts for support and questions.

## ● <u>Dolby Vision Metadata Overview</u>

1. Embedded metadata within the Video MXF of a native IMF Package, accessible by:
   - Clip inspector in compatible software (e.g., Colorfront Transkoder)
   - Extracting Dolby Vision metadata using Dolby Metafier
   - 
2. Separate XML sidecar metadata files, allowed only for non-native IMF picture file delivery under specific, pre-approved use cases with your GEM Post or Asset Management contact. Examples include:
   - ProRes4444 XQ paired with Dolby Vision metadata XML for servicing turnover
   - Legacy VDM deliveries accompanied by Dolby Vision metadata XML

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**Key Metadata Levels:**

- **Level 1 (Image Character analysis):** Required for all shots; used as the baseline for Dolby Vision metadata generation and tone mapping.
- **Dolby Vision 2.9:**
    - Level 2 <TID 1> (SDR Rec.709/100 nit trim pass) is optional and used if additional scene-specific color adjustments are needed; should be created before other level 2 trims.
    - Level 2 <other TIDs> represent specific display trim passes, e.g., TID 48 (P3 D65/1000 nit), TID 49 (Rec.2020 D65/1000 nit), TID 27 (P3 D65/600 nit).
- **Dolby Vision 4.0:**
    - Level 8 <TID 1> (advanced SDR Rec.709/100 nit trim pass) is optional and included if creative adjustments require it; must be done after Level 4.0 L1 and L3 passes.
    - Backward-compatible 2.9 L2 trim values auto-generate from 4.0 L1, L3, and L8 values.

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**Common QC Issues and Recommendations:**

- **Software Incompatibility:** Some mastering platforms may not correctly interpret Dolby Vision metadata from others. Use Dolby Metafier to extract and validate XML metadata, and Dolby CM Offline to render SDR derived masters for QC.
- **Image Character Values:** Frames incorrectly containing zeroed <ImageCharacter> values for non-black frames should be re-analyzed and corrected.
- **Color Mapping and Timing:** Metadata durations misaligned with video cuts cause luminance/color timing errors; validate using Dolby Metafier and clip inspectors and fix as needed.
- **Canvas and Image Aspect Ratios:** Incorrect settings cause mapping errors, visible as black level shifts or translucent bars in SDR outputs. Confirm <CanvasAspectRatio> matches full frame resolution and <ImageAspectRatio> matches the active image area (up to five decimal places), adjusting for letterboxing/pillarboxing. Use L5 metadata for shots deviating from global

aspect ratios where supported (e.g., Baselight v5.3+). Avoid positive lift values in trim passes to prevent black level artifacts.

**QC Partners:**
Always verify Dolby Vision Canvas and Image Aspect Ratios match deliverable resolutions. Visual cues of errors include elevated black levels or translucent matte bars appearing only in SDR streams.

For complete details and updates, please work closely with your GEM Post Management and Asset Management representative.

# Remote Color Grading and Reviews

### Introduction
Remote collaboration and review during look development, color grading, and final approval processes have become increasingly critical. This document presents various scenarios and technology options, along with their benefits and risks, aligned with our technical standards. Note that this is informational, not a requirements or endorsement document. The optimal solution varies by production needs and participant capabilities. We encourage dialogue and consultation with your dedicated GEM Post Management contact for project-specific guidance.

### Setting Realistic Expectations
Remote color grading and review setups cannot fully replicate carefully calibrated facility environments adhering to industry [standards] for monitor calibration and room lighting. Differences in calibration, color accuracy, and viewing conditions will affect image appearance. Such compromises may be acceptable during grading progress phases but not for final approval.

### Potential Limitations
- Calibration consistency across diverse devices
- Image quality degradation due to streaming compression
- Uncontrolled viewing environments with varied lighting and room color

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- Bandwidth constraints resulting in latency, compression artifacts, or regional throttling
- Data security considerations per [Home Studio Security Guidance]
- Additional time required for setup and adjustment in non-standard workflows

**Monitoring Scenarios**
While ideal color grading requires professional monitoring environments, sometimes remote reviews are necessary. Possible setups vary for HDR and SDR projects:

**HDR Grading and Review**
Professional HDR reference monitors are mandatory for final Dolby Vision HDR grading passes at GEM facilities. Colorists may perform initial grading using recommended consumer HDR monitors at home but should finalize on reference monitors. For HDR creative review by talent or executives, consult GEM's Post Management for recommended solutions.

**HDR Grading with SDR Review**
If at-home HDR monitoring is unavailable for creatives, reviewing the Dolby Vision-derived SDR version is a common industry practice. This approach allows grading progress in HDR while reviewing in SDR, with a final HDR pass planned.

**SDR Grading for HDR Titles**
Progress can continue using only SDR monitoring if color management is enabled (e.g., ACES workflows). Colorists work in SDR while maintaining the option to switch to HDR for final verification. A Dolby Vision SDR trim pass remains required before final HDR finishing.

**SDR Titles**
These guidelines apply equally to SDR-finished titles. Options for SDR review and monitoring are detailed below.

**Image Monitoring Resolution**
Most remote streaming solutions support HD (1920x1080) only, which is generally adequate for color work, though UHD (3840x2160) review is preferred for detailed image texture evaluation. Compression in video streams may obscure fine details compared to uncompressed facility reviews.

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### Creative Color Review

Most solutions rely on 8-bit H.264/AVC codecs, sufficient for general viewing but prone to banding and artifacts affecting color accuracy. 10-bit codecs offer better fidelity and are preferable.

### Non-Live Streaming Reviews

Colorists upload rendered files asynchronously for review by creatives, requiring session-based watermarking for security.

### Dolby Vision vs. HDR10

Remote reviews using consumer displays with Dolby Vision metadata generally yield superior color accuracy (e.g., on iPad Pro) compared to HDR10, but HDR10 provides an acceptable HDR experience for grading progress.

### Review Solutions

Available platforms include:

- [Moxion] (supports SDR, HDR10, Dolby Vision HDR)
- [Frame.io] (supports SDR, HDR10)
- [PIX] (SDR only)

In bandwidth-limited cases, local playback on iPad Pro (5th gen+) via Apple Files app for SDR/HDR files is possible. See [playback instructions] and [security settings] for details.

### Live Streaming Remote Color Review

Colorists work on calibrated monitors locally while streaming live video feeds to collaborators with secure authentication, ideally with two-factor authentication (2FA).

### Solutions include:

- [Streambox] (SDR, HDR)
- [Sohonet ClearView, Flex, Pivot]
- [Nevion]
- [Colorfront Remote Streaming]

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**Data Management and Custody**
File Integrity
Always validate file transfers with checksums (e.g., md5, mhl), providing manifests for verification.

**Recommended software:**

- [Hedge]
- [Shotput Pro]
- [Pomfort Silverstack]
- [YoYotta]

**Transferring Content**
When possible, use secure internet protocols like Aspera or Signiant, commonly supported by facilities and GEM Content Hub. For constrained bandwidth, use fully disk-encrypted physical drives.

**Preferred network options:**

- GEM Content Hub ingestion
- Vendor/facility secure transfer solutions
- Aspera, Signiant protocols
  Consult your GEM representative if alternatives are proposed.

**Physical Storage**
Use fully disk-encrypted drives (hardware preferred) for physical transfers. For recommended drives, see [Home Studio Security Guidance].

**iPad Pro Content**
Ensure iPadOS and playback apps are current, enable strong passcodes/biometric locks, activate 'Find My' feature, and only use official app stores. Report any lost or stolen devices with GEM content immediately.

**Working Storage**
All grading session storage must be disk encrypted (e.g., Windows Bitlocker, macOS Filevault).

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**Data Custody**

Follow GEM's [Home Studio Security Guidance]:

- Encrypt all disks fully
- Secure unused media in locked storage
- Delete temporary media promptly

**Color Grading**

A properly calibrated display is critical for home grading setups; calibrate for the environment.

**Color Management**

Utilize recognized color management systems (such as [ACES]) during remote review to maintain color accuracy across devices and display types.

**Remote Working Scenarios**

Various workflows exist depending on system access and technical proficiency:

- Colorist and content hardware at home for independent work
- Colorist at home controlling facility hardware remotely, requiring strong bandwidth and support
- Mirrored content across locations sharing synchronized projects/databases over VPNs
- Rendering deliverables from grading projects using up-to-date software (e.g., DaVinci Resolve 16.2.4+ supports tagged Dolby Vision IMF export)

**Remote Desktop/Application Control**

Depend on low-latency, dedicated bandwidth for remote control. Solutions:

- Teradici
- HP RGS
- Mechdyne TGX

**Displays**

Recommended displays (calibrated to standards) include:

**SDR References:**

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- Sony PVM-A250, BVM-F250
- Dolby PRM-4220
- Flanders FSI DM250


**SDR Consumer Examples:**

- LG OLED C-Series and G-Series (2022+)
- Sony OLED Bravia (2022+)
- Panasonic OLED (2022+)
- Apple iPad Pro
- Apple Pro Display XDR
- EIZO CG319X
- HP Dreamcolor z27x, z32x

HDR References (Dolby Vision grading capable) and Consumer Pre-grade monitors also noted.

## Calibration and Viewing
If ideal viewing environment is unavailable, maintain neutral, dimly lit rooms (6500K temperature). Avoid completely dark or overly bright conditions.

Recommended bias lighting and calibration tools:

- MediaLight 6500K Bias Lighting
- Portrait Displays C6 HDR2000 probe and CalMan software
- X-Rite i1 Display Pro Plus
- Light Illusion LightSpace (free temporary licenses available)

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# <u>What is Color Management?</u>

GEM's approach to color management involves best practices developed collaboratively between creatives, post-production facilities, and the Production Workflow Technology & Creative Tech Imaging team. While open standards like ACES exist, this overview explains what 'color managed' means across GEM projects, regardless of specific frameworks. GEM aims to enhance industry understanding and evolve standards such as ACES v2.0, making color management more accessible.

**Color Management Defined**
The term 'color managed' varies across contexts. For some, it could mean shooting and finishing in Rec. 709 and posting in ProRes on YouTube. At the highest level, such as in advanced VFX facilities, it involves working entirely within a scene-referred color space like ACES, using OpenColorIO for asset conversion, compositing CG and live-action elements, and delivering DPX or EXR files to DI for grading. This document clarifies GEM's intended meaning.

**GEM's Three Color Management Goals:**

1. Deliver predictable, repeatable color viewing and conversion across diverse capture devices and display types to maintain creative intent throughout production and post.
2. Perform all creative and VFX work in a scene-referred space to maximize post-production flexibility.
3. Create high-quality, future-proof archival masters preserving full creative information.

**Color Pipeline Explained**
A color pipeline defines the source, working, and delivery color spaces plus required transforms to maintain alignment between image capture, processing, and display. Coordination among all teams handling images is essential.

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- **Input Color Space:** Initial capture device color space (e.g., Sony SLog3/SGamut3.cine, RED Log3G10/WideGamutRGB, ARRI LogC/WideGamut), or display-referred sources like Rec.709/BT.1886 or sRGB.
- **Working Color Space:** Where image manipulation occurs. Sources not already in this space are converted first. Examples include ACES or dominant camera spaces. Working color spaces contain full dynamic range data and may not appear visually "correct" without output transforms.

- **Output Transform:** Converts the working space image to the display color space using an agreed LUT (look-up table) or viewing transform. It can also define the show's base creative look while preserving working space data and dynamic range.

- **Display Color Space:** The color space the display supports for correct image appearance (e.g., Rec.709/BT.1886, PQ ST.2084, P3-D65, Rec.2020).

**Example:** Working space is logarithmic; output transform maps to Rec.709/BT.1886 for streaming masters, while archival masters retain logarithmic data.

## Benefits of Color Management

- **Confidence & Trust:** Fewer color issues and rework mean more time for creativity. Alignment across production and post reduces costly fixes.

- **Viewing Flexibility:** Enables consistent image appearance across HDR, SDR, monitors, and projectors.

- **Archival Integrity:** Maintains all captured creative data for future projects, VFX reuse, and remastering.

## Fundamentals for Proper Color Management

- **Consistent Color Transforms:** Standards like ACES and software like OpenColorIO enable uniform color handling across hardware/software and

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support custom pipelines shared across facilities. Adoption is strong in VFX but expanding elsewhere.

- **High Bit Depth Precision:** Non-destructive color transformation requires high bit-depth (minimum 10-bit for SDR, 12-bit for HDR, ideally 16-bit or 32-bit floating point) formats and processing to avoid clipping and preserve quality.

**Stages of Color Management**

- **Pre-production:** Early alignment among DP, DIT, colorists, VFX, and GEM on camera choice, recording format, working color space (ACES or show LUT) improves color pipeline consistency downstream.

- **Display Calibration:** Essential for ensuring consistent, meaningful color decisions. Refer to GEM's [Color Critical Calibration Guidelines].

- **On-set Monitoring:** First major color judgment point; non-destructive, consistent CDL+LUT setups with calibrated monitors give downstream flexibility.

- **Dailies & Editorial:** Transfer on-set CDLs and LUTs via ALE files; editorial should see the same colors shot on set in matching working color space.

- **VFX:** Provide VFX vendors with thorough color pipeline documentation including plate encoding, color recipes, and reference frames to ensure scene-referred compositing and seamless editorial integration.

- **Final Color Grading:** Colorists should build on prior color decisions (CDL+LUT) in the working color space before applying output transforms, protecting creative intent and archival quality.

- **Archival:** Enables delivery of Non-graded Archival Masters (NAM) in a unified color space preserving full information. See GEM's [NAM specification].

**Example Pipeline**

By maintaining images in wide gamut, high dynamic range working spaces like ACES,

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one can simply select output transforms for target displays at each workflow stage. Alternatively, working in dominant camera spaces with careful color management and LUT usage achieves similar results.

This approach ensures color consistency from on-set through finishing, archival, and future use

## GEM HDR Color Pipeline Steps

### On-set & Dailies

1. Camera captures footage.
2. Camera Data Lists (CDLs) are generated for color look information.
3. CDLs feed into an Output Transform, which converts the working image into SDR or HDR display-referred color space (custom LUT or ACES Output Transform).
4. The transformed image is shown on a calibrated On-set HDR Monitor.
5. Offline Proxies are created for editorial and review.

### Editorial

6. Offline proxies (color baked with CDLs) are used to generate an edit list incorporating these CDLs.

### Finishing

7. 4K Online Conform of camera footage is aligned per edit list.

8. Digital Intermediate (DI) work is performed applying color grading in HDR working space.

9. DI color grading passes to:

- VFX department with maintained color pipeline and looking on VFX monitors.

- HDR Output Transform to create final Dolby Vision IMF master with embedded SDR metadata for compatibility.

- SDR Trim for SDR deliverables.

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- DCI-P3 Output Transform to create Digital Cinema Master (DCDM) files.

10. DCDM files are packaged into DCPs (Digital Cinema Packages) for theatrical distribution.

## GEM SDR Color Pipeline Steps

**On-set & Dailies**

1. Camera captures footage.
2. CDLs created for color look and injected into pipeline.
3. Output Transform converts imagery to SDR or HDR reference space as needed.
4. On-set HDR Monitor views the image.
5. Offline proxies created.

**Editorial**

6. Edit list generated with CDLs applied to offline proxies.

**Finishing**

7. 4K Online Conform performed using final edit.
8. Digital Intermediate color grading in working color space.
9. Graded image passed to:

- VFX pipeline, maintaining color accuracy, viewed on VFX monitors.
- Rec.709 Output Transform generates final Rec.709 IMF master for SDR delivery.
- DCI-P3 Output Transform creates DCDM files.
10. DCDM files are assembled into DCPs for theatrical markets.

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## Notes for Both Pipelines

- Output Transform refers to either custom creative LUTs or standardized ACES Output Transforms.
- All color pipelines preserve working color space integrity before mapping to final display spaces.
- SDR and HDR workflows maintain consistency from on-set through editorial, finishing, VFX, and archival.
- Dailies and proxies carry CDL metadata for color continuity.
- Deliverables include IMF files for streaming and DCP packages for cinema.

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- Visual QC and project collaboration depend on accurate color pipeline implementation.

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This stepwise breakdown can be recreated in any diagram or flowchart tool aligned with GEM's terminology and standards, providing a comprehensive workflow overview for color management across SDR and HDR projects.

## ● <u>iPad Pro For Remote Color Review</u>

**Settings & Configuration**
Guides are available for setting up iPad Pro display and brightness across generations for color review purposes. Reach to a GEM representative for iPad Guides Below:

- iPad Pro Gen 5–7 Display & Brightness Configuration
- iPad Pro Gen 2–4 Display & Brightness Configuration
- Security Settings for iPad Pro storing GEM content

**Rendering & Playback**
Instructions cover proper rendering of videos for review on iPad Pro, and correct playback methods. Streaming solutions replace the need for local playback and are not covered here.

**For Post Facilities:**

- iPad Pro Deliverables for Color Reviews: Accepted video formats and color encodings (SDR & HDR), with verification guidance.

**For iPad Pro Users:**

- Playing back files in Apple Files app: step-by-step instructions.

These materials ensure iPad Pro usage aligns with GEM's standards for color fidelity, security, and workflow efficiency during remote review.

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## ● <u>Color Managed Workflow in Resolve: ACES</u>

This document is designed to provide guidance for setting up DaVinci Resolve within an ACES color-managed workflow tailored for GEM productions. It describes one method for configuring Resolve to enable the creation of a Non-graded Archival Master (NAM) deliverable to GEM. The steps presented are recommendations rather than mandatory requirements and illustrate an ACES workflow without covering the full range of possible Resolve color management configurations.

**Blackmagic offers several tutorials to assist with color management setup:**

- ACES Setup in DaVinci Resolve
- ACES Deliverables Workflow
- Color Roundtrip from Dailies to Final Grading (Parts One and Two)

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**Understanding ACES**

For those interested in learning more about ACES, the Academy Color Encoding System, please visit ACES Central for primers and quick-start guides. Additional details related to ACES in Resolve can be found in the Color Management chapter of the latest DaVinci Resolve Manual.

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**Project Configuration**

After creating a new Resolve project, open Project Settings > Color Management. Set the Color Science to ACEScct, recommended unless there is a clear justification for ACEScc. Use the latest ACES version available.

**Match the ACES Output Device Transform to your display calibration:**

- For SDR workflows, select Rec.709 corresponding to monitors calibrated to Rec.709/BT.1886 at 100 cd/m² peak luminance.
- For HDR, select P3-D65 ST.2084 (PQ) tuned to your monitor's nit capability, typically P3-D65 ST.2084 at 1000 nits.

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Maintain the ACES Mid Grey Luminance setting at 15.00 throughout grading and finishing.

The application of Process Node LUTs depends on whether Look Modification Transforms (LMTs) are loaded as LUTs. The nature of LMTs determines this setting; further information is available from ACES Central.

If ACES Output Device Transform is set to None, Resolve outputs images in linear ACES space (ACES 2065-1 or AP0).

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**Importing Clips**

Raw footage is automatically debayered into ACES by Resolve, displaying correctly by default. For non-raw formats (e.g., DPX, ProRes, XAVC), manual selection of the ACES Input Device Transform (IDT) might be required.

You can assign IDTs by right-clicking clips or groups of clips in the Media Pool. For example, XAVC footage from Sony F55 using SLog3-SGamut3.CINE color space requires selecting the corresponding Input Device Transform manually if metadata is missing.

Alternatively, set a default ACES IDT in project settings for common clip types. Sorting clips by Format or Video Codec helps batch assign IDTs efficiently.

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**Rendering Deliverables**

In the Deliver page, configure exports per deliverable:

- For display-color-space deliverables (e.g., IMF Master, Video Display Master, QuickTime references), ensure ACES Output Transform is enabled and corresponds to the intended display.
- For the Non-Graded Archival Master (NAM), disable ACES Output Transform to export ACES AP0/Linear data.

Use the 'Enable Flat Pass' option on the Deliver page to render the NAM without grading.

**Recommended render settings for NAM include:**

- Single clip output

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- EXR file type
- RGB half float codec (lossless ZIP or PIZ compression)
- Render at the scene's working format resolution
- No Output Transform enabled
- Enable Flat Pass always on

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**Additional Notes**

The 'Force debayer to highest quality' option ensures Resolve uses the best debayer method per RAW but can be overridden for preferred algorithms.

Render resolution should generally meet or exceed UHD (3840 x 2160), depending on project framing.

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This workflow ensures color management consistency, protects image quality, and supports GEM's archival and delivery standards.

## ● <u>Color Managed Workflow in Baselight</u>

The procedures presented here are intended as recommended best practices rather than strict requirements. Two workflows are outlined: an ACES Workflow and a Camera Native Workflow. These represent common approaches but do not encompass all possible color management configurations within Baselight.

Filmlight has produced several tutorial videos to support color management understanding, covering topics such as:

- ACES project setup in Baselight, including overview, footage loading, CDL application, out-of-gamut color handling, Truelight Scene Looks from LMTs, and VFX plate preparation.
- RED IPP2 project setup, encompassing IPP2 DRT installation, scene setup, footage interpretation, custom DRTs, and VFX rendering.

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- ARRI color workflow, including ALF-2 DRT and Look Library installation, scene configuration, ARRIRAW and LogC handling, and VFX outputs.
- FilmLight's T-Log / T-CAM pipeline, covering scene templates, inverse DRT, scene look application, black level management, and VFX plate delivery.

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**ACES Workflow**

For those new to ACES, visit [ACES Central] for comprehensive resources on the Academy Color Encoding System.

**To configure:**

- In Job Manager, create a new scene using the ACES Template. This preselects ACEScct / AP1 as the Working Colour Space. Unless specifically required, retain ACEScct over ACEScc.
- Set Working Format resolution to UHD, 4K, or higher (unless GEM grants an exception). Frame rate should align with IMF and VDM delivery specs.
- Verify via Views > Scene Settings:
     - Under Views > Cursors, set Viewing Colour Space to match your reference monitor calibration; e.g., Rec.1886: 2.4 Gamma / Rec.709 for SDR grading.
       - Set Viewing Format to match IMF or VDM resolution.

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**Colour Space Journey**

After importing media into your scene, inspect Views > Colour Space Journey to confirm the color flow:

- Working Colour Space is ACEScct.
- Converted to Viewing Colour Space using the ACES RRT (indicated by "converted with family DRT").

**Example:** For an ACES archival OpenEXR source, this path is linear input → ACEScct working → ACES RRT viewing transform.

For a Dolby Vision grade on a 1000-nit display, Viewing and Master Colour Spaces switch accordingly.

Baselight debayers RAW sources into optimized camera native spaces (e.g., Sony Linear / S-Gamut3), then converts to ACEScct for grading, explaining the "Graded In" field.

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**Rendering Deliverables**

When ready to render:

- Open Views > Render. Create a Deliverable Set (named per your preference, e.g., "GEM Deliverables").
- For the NAM:
  - Set output to Single Clip, file type OpenEXR.
  - Use RGB half float codec with lossless zip or piz compression.
  - Set render format to equal the scene's working format.
  - Render colour space as ACES Linear / AP0.
- Exclude layers modifying color; include spatial transforms like Pan & Scan.

For file organization and naming, refer to GEM Content Hub guidelines.

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**Camera Native Workflow**

This workflow leverages camera manufacturer color spaces and transfer functions directly.

**Before launching Baselight:**

- Download camera-specific Truelight files (.flspace, .fltransform, .cub) into Baselight's color spaces directory.

Initialize a new scene ensuring UHD or 4K+ resolution (or as GEM permits) and matching delivery frame rate.

Assign the Working Colour Space to the log-encoded manufacturer space (e.g., Panasonic V-Log/V-Gamut, Sony S-Log3/S-Gamut3.Cine).

Open Views > Scene Settings to verify project-specific settings reflect the primary camera workflow.

For Dolby Vision, confirm Display Rendering Transform shows the "family DRT" icon indicating HDR/SDR variants.

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In Colour Space Journey, Baselight auto-debayers RAW footage to camera-native linear space before converting to working space for grading.

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**Rendering Deliverables in Camera Native Workflow**

- Remove unused deliverable tabs; define new deliverable set for GEM.
- For NAM:
  - Output in OpenEXR or DPX, uncompressed.
  - Render format equals working format.
  - Render colour space matches scene's linear native color space.
- Duplicate the tab for Graded Archival Master (GAM) with similar settings but 16-bit format.
- Duplicate again for Dolby Vision Video Display Master (VDM) as 16-bit TIFF matching IMF delivery format and Dolby mastering display color space.
- Duplicate again for SDR VDM as 16-bit DPX matching IMF format and viewing color space (typically Rec.1886 2.4 Gamma / Rec.709).

Refer to GEM Content Hub for precise folder structures and file naming conventions

# ● <u>Dolby Vision HDR Mastering Guidelines</u>

For all GEM Originals delivered in HDR, mastering in Dolby Vision is mandatory, following GEM's [IMF delivery specifications] for Dolby Vision packages. These packages enable GEM to generate Dolby Vision, HDR10, and SDR streams for audience playback.

Update: Dolby Vision 4.0 is now supported for GEM deliveries but is not required; GEM continues to accept Dolby Vision 2.9.

# GEM

**Widely supported color grading software compatible with Dolby Vision includes:**

- Blackmagic Resolve Studio
- Filmlight Baselight
- Digital Vision World Nucoda

**Packaging tools supporting Dolby Vision include:**

- Colorfront Transkoder
- Rohde & Schwarz Clipster
- Blackmagic Resolve Studio
- MTI Film Cortex Enterprise Edition

**Blackmagic provides [tutorials] for HDR mastering guidance.**

All Dolby Vision 4.0 deliveries must include CMVersion [4 1] metadata embedded within the IMF picture track.

**Requirements:**

- Professional HDR monitor calibrated to Dolby Vision specs: P3-D65 color gamut, PQ/ST.2084 electro-optical transfer function, and ≥1000 cd/m² brightness.
- Professional SDR monitor calibrated to Rec.709, BT.1886 / Gamma 2.4, at 100 cd/m².
- Color grading software with Dolby Vision support, list available [here].
- Dolby Vision license enabling either hardware (external Content Mapping Unit, eCMU) or software (internal Content Mapping Unit, iCMU).

**Deliverables:**

- Dolby Vision IMF package with embedded metadata.
- Refer to GEM Originals Delivery Specifications for full guidance.
- Validate metadata accuracy—color encoding, mastering display, aspect ratio—using Dolby's Metafier tool before delivery.

**Contacts:**

- Dolby licensing, certification & training:
  Thomas Graham (tom.graham@dolby.com)
- Ian Lowe (ian.lowe@dolby.com)
- GEM workflow and delivery support: [info@gemtreams.tv]

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**FAQs:**

- Dolby offers worldwide training & certification for colorists, engineers, and post professionals; contact Dolby for details.
- HDR should be graded first as the 'hero grade,' followed by a shot-by-shot Dolby Vision trim pass. This achieves optimal HDR and SDR results. The final deliverable includes an HDR master and sidecar XML metadata for trims.

- Monitor calibration depends on device technology. Refer to [Color Critical Display Calibration Guidelines] for SDR and HDR standards:

| Aspect | HDR Monitoring | SDR Monitoring |
|---|---|---|
| Color Gamut | P3 | Rec. 709 |
| White Point | D65 | D65 |
| EOTF | PQ / ST.2084 | BT.1886 (2.4 Gamma) |
| Peak White | 1000 / 2000 / 4000 nits | 100 cd/m² |

- For ACES workflows, choose Output Transforms matching your monitor: P3-D65 ST.2084 at 1,000 or 4,000 nits.

- GEM recommends calibrating to P3-D65 rather than Rec.2020 to avoid inconsistencies due to monitor primary variations; P3 matches most mastering monitors' largest reproducible gamut currently.

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## ● <u>Color Critical Display Calibration Guidelines</u>

To ensure consistency, all GEM Originals delivered in HDR must be mastered in Dolby Vision and comply with our [IMF delivery specifications] for Dolby Vision packaging. From these packages, Dolby Vision, HDR10, and SDR streams are created for viewers.

Update: GEM now supports Dolby Vision 4.0 deliveries, but they are not mandatory. GEM continues to accept Dolby Vision 2.9 versions.

**Supported software for Dolby Vision color grading includes:**

- Blackmagic Resolve Studio
- Filmlight Baselight
- Digital Vision World Nucoda

**Packaging solutions include:**

- Colorfront Transkoder
- Rohde & Schwarz Clipster
- Blackmagic Resolve Studio
- MTI Film Cortex Enterprise Edition

Blackmagic provides [tutorial videos] on HDR mastering with Dolby Vision.

Dolby Vision 4.0 deliveries must include CMVersion [4 1] and Dolby Vision metadata embedded within the IMF picture track file.

**Requirements:**

- Professional HDR monitor meeting Dolby Vision specs: P3-D65 gamut, PQ/ST.2084 EOTF, ≥1000 cd/m² luminance.
- Professional SDR monitor calibrated to Rec.709, BT.1886/Gamma 2.4, 100 cd/m².
- Color grading software supporting Dolby Vision (full list [here]).
- Dolby Vision license enabling hardware (eCMU) or software (iCMU) Content Mapping Units.

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**Deliverables:**

- Dolby Vision IMF with embedded metadata per GEM Originals Delivery Specifications.
- Verify metadata accuracy with Dolby's Metafier tool covering color encoding, mastering display, and aspect ratio before submission.

**Contacts for licensing, certification, and training:**

- Thomas Graham (tom.graham@dolby.com)
- Ian Lowe (ian.lowe@dolby.com)

For GEM workflow and delivery support contact GEM's technical team.

FAQ Highlights:

- Dolby Vision training and certification are globally available from Dolby.
- Grade HDR first as the primary "hero" grade, then perform shot-by-shot Dolby Vision analysis and trim passes.
- Calibrate monitors per device capabilities—details are in [Color Critical Display Calibration Guidelines]:

| Feature | HDR Monitor | SDR Monitor |
|---|---|---|
| Color Gamut | P3 | Rec.709 |
| White Point | D65 | D65 |
| EOTF | PQ / ST.2084 | BT.1886 (Gamma 2.4) |

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| Peak Luminance | 1000 / 2000 / 4000 nits | 100 cd/m² |
| --- | --- | --- |

- For ACES workflows, use P3-D65 ST.2084 Output Transforms at target nit levels (e.g., 1000 or 4000 nits).
- GEM recommends calibrating to P3-D65 rather than Rec.2020 due to variability in monitor primaries, ensuring more consistent mastering results. P3 currently represents the largest color gamut reproducible on mastering reference monitors.

## ● <u>Titles & Graphics: Requirements & Best Practices</u>

**Introduction**
These guidelines stem from extensive experience with various content types and workflows, but the best approach may differ per project. GEM provides dedicated support personnel to assist in setting up workflows for success. It is crucial to understand the foundational requirements and recommendations before production starts. Please contact your GEM Post Manager or Production Technology Specialist with questions.

**Requirements**
Titles and graphics (GFX) should be created within a canvas at least UHD resolution wide (3840 pixels) and adhere to the finishing aspect ratio.
If the project's final finishing format is narrower than 3840 pixels, consult GEM Post Management for specifications.
Framing charts and final aspect ratio details must be shared with all vendors to ensure consistent resolution, framing, and pixel-accurate alignment throughout the imaging workflow.

Accepted delivery formats for Titles & GFX include:

- 16-bit OpenEXR (.exr) with either uncompressed or lossless ZIP/PIZ compression (LOG EXRs are not accepted)

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- 16-bit uncompressed TIFF (.tif)
- 16-bit DPX (only for fullscreen, non-composited elements)
- ProRes 4444 may be permitted for select nonfiction and animation projects

If sidecar mattes or alpha channels are used, they must have 1:1 frame numbering with the fill.

Establish and communicate the project-wide color pipeline to all vendors.
Early round-trip testing among title vendors, editorial, and DI teams is required to verify color pipeline consistency.

Any Show Looks (LUTs, CDLs, LMTs) applied must be shared with all vendors to guarantee uniform color reproduction across the production.

**Note:** Graphics and titles created in Linear ACES must be delivered as 16-bit EXR (.exr).

**Best Practices**
**Title Safe and Safe Action**
While GEM does not enforce strict text or graphics placement rules, it recommends following SMPTE guidelines:

- Title Safe: 90% of the 16x9 full frame
- Safe Action: 93% of the 16x9 full frame

If text or graphics exceed the safe action area or border the frame edges, GEM typically requests confirmation from the creative team that this is intentional.
For moving text/graphics, readability within safe action at any point is sufficient, even if starting or moving outside the safe area.

**Color Grading Plates and Pulls**
Debayering of plates/pulls should be performed by the finishing facility when possible.
Any live-action plates used for titles or GFX creation should be processed consistently with the finishing grade protocol.

For example, if final grading uses ACES, plates for titles and graphics must also be prepared in ACES.

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Pre-timing or color balancing should occur in scene-referred spaces such as ACES or camera log space if required.

**Delivery, Archival, and Wrap**
Title & GFX vendors must confirm final delivery formats, including container type (TIFF, EXR) and compression (uncompressed, ZIP, PIZ) with the finishing facility.
All final rendered files with embedded or sidecar mattes and alphas should be delivered to GEM via Content Hub for archiving.

Project files, textless shot versions, and associated mattes should be included.
Prior to final wrap, GEM may request an archival GFX "Toolkit" containing:

- Textless backplates
- Editable font layers (live type or Illustrator files, not rasterized)
- Lists of plugins (with versions) and fonts used in graphics
- Documentation of compositing color spaces

**Editorial**
Offline editorial and title/GFX vendors must communicate proxy media format requirements clearly.

**Anamorphic Capture**
Title and GFX teams should align with the DI facility regarding whether the finishing pipeline uses squeezed or unsqueezed formats.

**HDR**
GEM places no specific limits on text brightness for HDR content but generally recommends between 100 and 400 nits for HDR shows.
When delivering HDR finishes, SDR graphics are often derived from the HDR versions; early testing of sample frames in both SDR and HDR is critical for color and compositing accuracy.

**Color Management**
Many popular Title and GFX software default to display-referred color spaces using ICC

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profiles (typically sRGB), which limits color fidelity compared to modern camera footage.

Until these programs support scene-referred workflows such as ACES, it is best practice to generate elements in sRGB or other standard ICC spaces, then apply Input Transforms or LUTs to transition assets into the project's working color space. Exploring tools like OpenColorIO that integrate modern pipelines like ACES may provide advanced color fidelity and improved pipeline integration.

## ● <u>Image Blow-Up Considerations</u>

When enlarging images, it's essential to maintain effective resolution standards. Any image blow-up resulting in a resolution below 4K is counted against the allowance for non-approved 4K camera footage within GEM projects. The table below summarizes the maximum permissible blow-up factors based on various source image resolutions, ensuring that the effective resolution remains at least 4K.

| Source Image Resolution | Maximum Blow-up Factor | Effective Blow-up Resolution |
|---|---|---|
| 8K | 2.0x | 4K |
| 7K | 1.75x | 4K |
| 6K | 1.5x | 4K |

| | | |
|---|---|---|
| 5K | 1.25x | 4K |
| 4K | 1.0x | 4K |

These guidelines help maintain image quality and adherence to GEM's footage delivery policies.

## ● <u>**Archival and Found Footage Best Practices**</u>

**Purpose**
These recommendations are designed to help maximize image quality during finishing and minimize costly errors in post-production when working with archival or found footage. The guidelines below provide a general overview of proven approaches, although optimal choices may vary per project.

**Please contact your GEM Post lead for project-specific advice.**

**Choose Final Aspect Ratio Early**
Decide on your finishing aspect ratio (e.g., 1.78:1) before editing begins to ensure smooth translation from offline editorial to finishing stages.
Apply framing, camera moves, and creative decisions within an offline editorial canvas matching the finishing aspect ratio (using mattes if necessary) to preserve creative intent through finishing.

Coordinate closely with your finishing facility on best practices to ensure moves and framing made offline translate accurately to finishing tools.

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### Ensure Non-destructive Workflow and Proxy Relinking

Create editorial proxies from original source files allowing seamless relinking back to those sources within the finishing system. Validate proxy workflows early with your finishing vendor.

### Perform Frame Rate Conversion and Scaling During Finishing

Archive and found footage should be passed to finishing at or near native raster, aspect ratio, frame rate, and quality whenever possible. This allows clip-by-clip frame rate conversion and raster scaling decisions in finishing, offering creative flexibility and easing QC fixes.

### Align Early and Frequently with Downstream Partners

For projects with substantial archival material (e.g., documentaries), engage finishing facilities early in offline workflows to establish archival treatment best practices. Test representative footage samples through complete pipelines to confirm offline to finishing translation and ensure archival treatments realize creative vision.

### Prepare for Pre-purchase Vs. Final Archival Assets

Pre-purchase archival versions may differ in frame rate, name, aspect ratio, or resolution from final purchased masters. Allocate schedule and plan discussions early to manage these differences effectively.

### Frame Rate Conversion Methods

No universal method exists; multiple tools and techniques may be employed per shot including:

- Frame duplication or removal
- Speed adjustment via re-interpretation
- Frame blending
- Full frame generation

### QC Philosophy

GEM's QC process centers on preserving creative intent. While technical defects are flagged, resolution is collaborative, focusing on production needs rather than strict correction mandates.

Archival projects may present many flagged issues; each is discussed to facilitate creative-forward progression.

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**Common QC Issues in Archival Projects:**

- Dead pixels
- Issues from low-quality video or frame rate conversions
- Aliasing, interlacing artifacts, motion stutter, unintended frame blends
- Video artifacts such as banding, posterizing, macro blocking, dirt, dust, or moiré patterns
- Frame edge mismatches, e.g., adjacent shots with inconsistent 4:3 formatting