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### Title

University of California Libraries Digital Reformatting Guidelines

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### Authors

Elnabli, Stefan  
Fogel, Paul  
Milenkiewicz, Eric  
et al.

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# UNIVERSITY OF CALIFORNIA LIBRARIES DIGITAL REFORMATTING GUIDELINES

March 2020

## Authors

Stefan Elnabli (UCSD); Paul Fogel (CDL); Eric Milenkiewicz (UCR); Susan Chesley Perry (UCSC); Chrissy Rissmeyer (UCSB); Hannah Tashjian (UCB)



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# UNIVERSITY OF CALIFORNIA LIBRARIES DIGITAL REFORMATTING GUIDELINES

MARCH 2020

The University of California Digital Reformatting Guidelines (UCDRG) is an update to the 2011 [CDL Digital File Format Recommendations: Master Production Files \(CDL DFFR\)](#). It is designed only to be a reference point and recommendation for preservation-level digital reformatting of the major object types: text, image, audio, video, and motion picture film. The guidelines focus on preservation file formats suitable for long-term digital storage. Intended for reference by UC institutions that are involved in digitizing analog content or preparing born digital media for preservation, this document is based on published standards that are referenced throughout the document and attributed where reproduced.

## About This Document

The UCDRG's intended audience is all UC campuses and campus groups. This document is not intended to address all administrative and technical issues surrounding the creation or management of digital files and resources. In this document, see "Digital Reformatting File Specifications" for preservation file format recommendations. Noteworthy considerations such as Quality Assurance and Quality Control, Metadata, and Accessibility are addressed in discussion form with pointers to relevant guidelines, but these topics are not the primary focus of this document.

The guidelines are largely based on these general characteristics:

- Non-proprietary
- Open, documented standards
- In common usage by the research community
- Standard character encodings (e.g. ASCII, UTF-8)
- Unencrypted
- Uncompressed or Lossless

## Accessibility Requirements

If digital objects are meant for public consumption now or in the future, then University of California systemwide legal accessibility requirements of WCAG 2.0 must be followed as per the [UC Information Technology Accessibility Policy](#).

## Document Maintenance

This document will be maintained and revised under the [University of California Libraries Direction and Oversight Committee \(DOC\)](#) on an ad hoc basis.

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# TEXT REFORMATTING GUIDELINES

## Introduction

Addressed here are digitization practices for textual materials that can be reproduced as still images, with a focus on unbound documents, bound volumes, and newspapers.

The Federal Agencies Digital Guidelines Initiative (FADGI) *Technical Guidelines for Digitizing Cultural Heritage Materials* were selected to serve as the basis for this document due to their widespread adoption across cultural heritage institutions (including the Library of Congress) and the digitization vendor community. Recommendations are based on FADGI 3 and 4 Star compliance. For a more in-depth discussion of digitization essentials for textual materials please refer to the complete FADGI guidelines.<sup>1</sup>

## Digital Reformatting File Specifications

Acceptable master file formats include TIFF, JPEG 2000, and PDF/A. Derivative files should be produced using the master file and the derivative format selected should be optimized as needed when aligned with a use case. There is no prescribed format for derivative files as these are considered secondary items by nature and generally not a permanent part of an archival collection. Lossless compression is approved for all uses, though compression may be appropriate for both master and derivative files in particular use cases.

### Unbound Documents

<b>Imaging Technology</b>	Digital Camera / Planetary Scanner / Sheet fed Scanner* / Flatbed Scanner*
<b>Master File Format</b>	TIFF, JPEG 2000, PDF/A
<b>Resolution (min.)</b>	400ppi
<b>Bit Depth</b>	16
<b>Color Space</b>	Adobe 1998 / ProPhoto / ECIRGBv2 / sRGB*
<b>Color</b>	Color

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<sup>1</sup> <http://www.digitizationguidelines.gov/guidelines/digitize-technical.html>

<b>Performance Level</b>	FADGI 4 Star compliant
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Bound Volumes

<b>Imaging Technology</b>	Digital Camera** / Planetary Book Scanner**
<b>Master File Format</b>	TIFF / JPEG 2000 / PDF/A
<b>Resolution (min.)</b>	400ppi
<b>Bit Depth</b>	8* / 16
<b>Color Space</b>	Adobe 1998 / ProPhoto / ECIRGBv2 / sRGB*
<b>Color</b>	Color
<b>Performance Level</b>	FADGI 4 Star compliant

Newspapers

<b>Imaging Technology</b>	Digital Camera / Planetary Scanner / Sheet fed Scanner / Flatbed Scanner
<b>Master File Format</b>	TIFF / JPEG 2000 (w/lossy compression)*** / PDF/A
<b>Resolution (min.)</b>	300ppi
<b>Bit Depth</b>	8
<b>Color Space</b>	Grey Gamma 2.2 / sRGB

<b>Color</b>	Grayscale or Color
<b>Performance Level</b>	FADGI 3 Star compliant***

\* Only to be used for General Collection materials

\*\* Equipment to be used manually without glass or glass platens and when using a digital camera, book cradles should also be utilized for Rare and Special materials

\*\*\* Recommended parameters for newspaper digitization by FADGI

### Quality Assurance and Quality Control

Inspection of files should involve two processes:

1. Technical inspection of the file to ensure that the correct imaging parameters were used during image capture and that the file itself is valid. The JHOVE<sup>2</sup> software tool is recommended for this.
2. Visual review of all thumbnail images, followed by a detailed examination of 10 images or 10% of each batch (whichever is larger) to assure completeness and consistency of the imaging. Should be conducted by the imaging technician and subsequently by another individual.

Example: Inspect file related properties to confirm that the file is in the proper format, resolution, and color mode. Inspect item related properties to identify any distortion, orientation, or cropping issues.

### Metadata

Many technical parameters are discussed in this document that define a high quality master image file, however an image is not considered to be of high quality unless metadata is associated with the file. Common metadata types for imaging projects include: descriptive, administrative, rights, and technical. Some forms of metadata are embedded within the file itself (e.g., technical) while others are stored outside of the file (e.g., descriptive).

Example: Dublin Core descriptive metadata that describes the content of the resource in an associated spreadsheet.

### Accessibility

Still images of textual material essentially lock the text within the file, making it inaccessible to technologies such as search engines and screen readers. Utilizing optical character recognition (OCR) on derivatives used for online display is a recommended action to comply with UC's WCAG 2.0 requirement so that the content can be indexed for greater accessibility. It is required that UC

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<sup>2</sup> <http://jhove.openpreservation.org/>

campuses and campus groups refer to [systemwide legal accessibility requirements of WCAG 2.0](#) if digital objects are intended for public access now or in the future.

Example: Convert a TIFF master file into an OCR'd PDF that is web accessible.

### **Glossary**

The Federal Agencies Digital Guidelines (FADGI) Initiative provides a helpful glossary of terms found [here](#).



# IMAGE REFORMATTING GUIDELINES

## Introduction

Addressed here are digitization practices for still images, with a focus on prints and photographs as well as photographic transparencies and negatives.

The Federal Agencies Digital Guidelines Initiative (FADGI) *Technical Guidelines for Digitizing Cultural Heritage Materials* were selected to serve as the basis for this document due to their widespread adoption across cultural heritage institutions (including the Library of Congress) and the digitization vendor community. For a more in-depth discussion of digitization essentials for still images please refer to the complete FADGI guidelines.<sup>3</sup>

## Digital Reformatting File Specifications

The acceptable master file format is TIFF. Derivative files should be produced using the master file and the derivative format selected should be optimized as needed when aligned with a use case. There is no prescribed format for derivative files as these are considered secondary items by nature and generally not a permanent part of an archival collection.

### Prints and Photographs

<b>Imaging Technology</b>	Digital Camera / Planetary Scanner / Flatbed Scanner
<b>Master File Format</b>	TIFF
<b>Resolution (min.)</b>	600 ppi*
<b>Bit Depth</b>	16
<b>Color Space</b>	Adobe 1998 / ProPhoto / ECIRGBv2 / sRGB
<b>Color</b>	Color
<b>Performance Level</b>	FADGI 4 Star compliant

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<sup>3</sup> <http://www.digitizationguidelines.gov/guidelines/digitize-technical.html>

\* Oversize materials (e.g., maps, posters) require minimum 300 ppi and 400 ppi for FADGI 3 Star and 4 Star respectively

#### Photographic Transparencies and Negatives

<b>Imaging Technology</b>	Digital Camera / Planetary Scanner / Flatbed Scanner / Film Scanner
<b>Master File Format</b>	TIFF
<b>Resolution (min.)</b>	4000 ppi* / 2000** ppi
<b>Bit Depth</b>	16
<b>Color Space</b>	Grey Gamma 2.2 / Adobe 1998 / ProPhoto / ECIRGBv2
<b>Color</b>	Grayscale / Color
<b>Performance Level</b>	FADGI 4 Star compliant

\* For photographic transparencies and negatives sized 35mm to 4" x 5"

\*\* For photographic transparencies and negatives larger than 4" x 5"

#### **Quality Assurance and Quality Control**

Inspection of files should involve two processes:

1. Technical inspection of the file to ensure that the correct imaging parameters were used during image capture and that the file itself is valid. The JHOVE<sup>4</sup> software tool is recommended for this.
2. Visual review of all thumbnail images, followed by a detailed examination of 10 images or 10% of each batch (whichever is larger) to assure completeness and consistency of the imaging. Should be conducted by the imaging technician and subsequently by another individual.

Example: Inspect file related properties to confirm that the file is in the proper format, resolution, and color mode. Inspect item related properties to identify any distortion, orientation, or cropping issues.

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<sup>4</sup> <http://jhove.openpreservation.org/>

## **Metadata**

Many technical parameters are discussed in this document that define a high quality master image file, however an image is not considered to be of high quality unless metadata is associated with the file. Common metadata types for imaging projects include: descriptive, administrative, rights, and technical. Some forms of metadata are embedded within the file itself (e.g., technical) while others are stored outside of the file (e.g., descriptive).

Example: Dublin Core descriptive metadata that describes the content of the resource in an associated spreadsheet.

## **Accessibility**

Web Content Accessibility Guidelines (WCAG) outline a set of recommendations for making Web content accessible. It is required that UC campuses and campus groups refer to [systemwide legal accessibility requirements of WCAG 2.0](#) if digital objects are intended for public access now or in the future.

Example: For historical images, incorporate text alternatives that provide descriptive identification of the non-text content.

## **Glossary**

The Federal Agencies Digital Guidelines (FADGI) Initiative provides a helpful glossary of terms found [here](#).

# AUDIO REFORMATTING GUIDELINES

## Introduction

Essential to an audio reformatting operation are hardware and software designed for uncompressed or lossless analog-to-digital conversion, preservation file format selection, ancillary data packaging, and quality control. Refer to [IASA-TC 04](#) for in-depth discussion of these essentials, as well as explanations of file format standards for preservation and access. IASA-TC 04 was selected because it is the de facto standard for audio digitization, preservation, and access.

## Digital Reformatting File Specifications

Container formats and codecs vary. Refer to [IASA-TC 04 Section 2](#) for a discussion of container format and codec selection for digital reformatting. In a preservation context, lossy formats are not recommended. Uncompressed (e.g., linear PCM) or Lossless (e.g., FLAC) are recommended codecs, while container formats may vary depending on institutional requirements for embedded metadata (e.g., WAVE, BWF).

## Analog Source

Digitization Input: Play analog source into encoder

Digitization Output: Wrap output as BWF or WAVE

## Audio Characteristics

Technical Specification	Preservation-Level	CD Quality-Level for Adequate Results
Sampling Rate	96 khz	44.1 khz
Bit Depth	24-bit	16-bit

While it is recommended to reformat audio objects using Preservation-level specifications, see IASA-TC discussion of [Sampling Rate and Bit Depth](#) to understand why CD Quality-Level might be preferred.

## Digital Source

Sampling rate and bit-depth should be equal to or greater than that of the audio recorded/stored on the carrier format (e.g., compact disc). See discussion of reformatting from a variety of original carriers in [IASA-TC 04 Section 5](#).

Example: In optical media like Compact Discs and DVDs, you may choose to make a disc-image or extract the audio for preservation.

## Quality Assurance and Quality Control

Quality Assurance ensures proper creation and delivery of target preservation file formats while Quality Control ensures the integrity and faithfulness of a target preservation file format to its source. Utilize available tools for this endeavor like [Quadriga Audio](#) or [mdqc](#).

Example: An [md5 checksum](#) is created after file creation and verified after delivery to its destination.

## Metadata

[IASA-TC 04](#) addresses technical, preservation, and ancillary data associated with the target preservation file format. It's assumed that reformatting hardware and software generate appropriate technical metadata within the target preservation file format. Other common types of preservation and ancillary data may include process history and descriptive information. It is not always the case that this data can be embedded in the target preservation file format, so it may be the case that sidecar files are preserved alongside preservation audio files. Determine your institution's requirements and means of preserving metadata, and refer to [IASA-TC 04](#) for guidance.

Example: Transcripts, structural metadata, and preservation action history are forms of ancillary data that can be preserved as embedded metadata in the target preservation file format or sidecar files to be included alongside multi-part digital objects for preservation.

## Accessibility

Web Content Accessibility Guidelines (WCAG) outline a set of recommendations for making Web content accessible. It is required that UC campuses and campus groups refer to [systemwide legal accessibility requirements of WCAG 2.0](#) if digital objects are intended for public access now or in the future. Refer to [Guideline 1.2 – Time-based Media](#).

## Glossary

The Federal Agencies Digital Guidelines (FADGI) Initiative provides a helpful glossary of terms found [here](#).

# VIDEO REFORMATTING GUIDELINES

## Introduction

Essential to a video reformatting operation are hardware and software designed for uncompressed or lossless analog-to-digital conversion, preservation file format selection, ancillary data packaging, and quality control. Refer to [IASA-TC o6 Guidelines for the Preservation of Video Recordings](#) for in-depth discussion of these essentials, as well as explanations of file format standards for preservation and access. Refer to [Refining Conversion Contract Specifications: Determining Suitable Digital Video Formats for Medium-term Storage](#) for quick-view technical specifications. These resources were selected because they continue to be an essential reference for video digitization, preservation, and access.

## Digital Reformatting File Specifications

Container formats and codecs vary. Refer to [IASA-TC o6](#) for a discussion of container format and codec selection for digital reformatting in a variety of contexts. Refer to [Refining Conversion Contract Specifications: Determining Suitable Digital Video Formats for Medium-term Storage](#) for quick-view technical specifications. In a preservation context, lossy formats are not recommended. Uncompressed (e.g., v210) or Lossless (e.g., FFV1) are recommended codecs, while container formats may vary depending on institutional requirements for embedded metadata (e.g., .mov, .avi, .mxf).

## Analog Source - NTSC or PAL<sup>5</sup>

Digitization Input: Play analog source into encoder

Digitization Output: Wrap output as .mov, .avi, or .mxf

## Video Characteristics

<b>Video Compression Codec</b>	Uncompressed (v210) or Lossless (FFV1)
<b>Frame Size (Standard Definition)</b>	720 x 486 (NTSC); 720 x 576 (PAL)
<b>Frame Size (High Definition)</b>	Native

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<sup>5</sup> Adapted from [http://www.digitizationguidelines.gov/audio-visual/documents/IntrmMastVidFormatRecs\\_2011001.pdf](http://www.digitizationguidelines.gov/audio-visual/documents/IntrmMastVidFormatRecs_2011001.pdf)

<b>Aspect ratio (Native)</b>	4:3 (SD); 16:9 (HD)
<b>Bit Depth</b>	10-bit
<b>Color Space</b>	YCbCr
<b>Chroma subsampling</b>	4:2:2
<b>Interlaced/Progressive</b>	Native
<b>Frame Rate (Native)</b>	30 or 29.97 (NTSC); 25 (PAL)

Audio Characteristics

<b>Audio channels</b>	Same as original
<b>Audio compression</b>	Uncompressed, PCM
<b>Audio sample rate</b>	48 kHz
<b>Audio resolution</b>	24-bit

**Digital Source - NTSC or PAL<sup>6</sup>**

[IASA-TC 06](#) outlines format migration in three categories: digitizing, transcoding, and rewrapping. When reformatting a digital source, focus on the latter two categories of transcoding and rewrapping. Do not introduce transcoding or rewrapping into the reformatting process for digital sources unless the

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<sup>6</sup> Adapted from [http://www.digitizationguidelines.gov/audio-visual/documents/IntrmMastVidFormatRecs\\_20111001.pdf](http://www.digitizationguidelines.gov/audio-visual/documents/IntrmMastVidFormatRecs_20111001.pdf)

essence data or file format are archaic or unusable for access. Maintain as many native characteristics of the video as possible while retaining any embedded and associated metadata.

Reformatting Options: Keep as-is, transfer essence data to wrapper of institutional preference, or transcode only if essence data or file format are archaic or unusable for access

Wrapper Options: Keep native wrapper with underlying encoded essence (e.g., .dv, .imx, .mpeg, .mp4, .mov, .avi, etc.), or if archaic or unusable for access then wrap in your container format of institutional preference

Video Characteristics

<b>Video Compression</b>	Native
<b>Frame Size (Standard Definition)</b>	Native
<b>Frame Size (High Definition)</b>	Native
<b>Aspect ratio (Native)</b>	4:3 (SD); 16:9 (HD)
<b>Bit Depth (Native)</b>	8-bit or 10-bit
<b>Color Space (Native)</b>	YCbCr
<b>Chroma subsampling (Native)</b>	4:2:2, 4:1:1, or 4:2:0
<b>Interlaced/Progressive</b>	Native
<b>Frame Rate (Native)</b>	30 or 29.97 (NTSC); 25 (PAL)

Audio Characteristics

<b>Audio channels</b>	Same as original
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<b>Audio compression (Native)</b>	Typically uncompressed, PCM
<b>Audio sample rate (Native)</b>	Typically 48 kHz
<b>Audio resolution (Native)</b>	Typically 16-bit or 24-bit

### Quality Assurance and Quality Control

Quality Assurance ensures proper creation and delivery of target preservation file formats while Quality Control ensures the integrity and faithfulness of a target preservation file format to its source. Refer to [IASA-TC o6](#) for a discussion of quality assurance and control, and utilize available tools for this endeavor like [qctools](#) and [mdqc](#).

Example: An [md5 checksum](#) is created after file creation and verified after delivery to its destination.

### Metadata

[IASA-TC o6](#) addresses technical, preservation, and ancillary data associated with the target preservation file format. It should be assumed that reformatting hardware and software generate the appropriate technical metadata concerning picture and sound within the target preservation file format. Other common types of preservation and ancillary data may include process history and time code. It is not always the case that this data can be embedded in the target preservation file format, so it may be the case that sidecar files are preserved alongside preservation video files. Determine your institution's requirements and means of preserving metadata, and refer to [IASA-TC o6](#) for guidance.

Example: Captions, subtitles, and teletext are forms of ancillary data that can be preserved as embedded metadata in the target preservation file format or sidecar files to be included in a digital object for preservation.

### Accessibility

Web Content Accessibility Guidelines (WCAG) outline a set of recommendations for making Web content accessible. It is recommended that UC campuses and campus groups consider the [guidelines for Time-based media](#) when strategizing ancillary data for preservation and access.

Example: Captioning and Subtitles can be utilized by video players to make video accessible. When extracting Closed Captioning information from a video signal, the encoded text can be converted to [SRT files](#) as part of your digital object to preserve, either embedded or saved as a sidecar file with your target preservation file format

### Glossary

The Federal Agencies Digital Guidelines (FADGI) Initiative provides a helpful glossary of terms found [here](#).

# MOTION PICTURE FILM REFORMATTING GUIDELINES

## Introduction

Essential to a motion picture reformatting operation are hardware and software designed for uncompressed or lossless analog-to-digital conversion, preservation file format selection, ancillary data packaging, and quality control. Film scanning is the recommended method. Refer to [FADGI Digitizing Motion Picture Film](#) (FADGI-DMPF) for in-depth discussion of these essentials, as well as explanations of file format standards for preservation and access. Refer to [NARA Digital Moving Images from Film-based Source Material](#) for quick-view input and output specifications. These resources were selected because they continue to be an essential reference for motion picture film digitization, preservation, and access.

FADGI-DMPF acknowledges that motion picture film reformatting is an emergent discipline. Note that in-house digitization of motion picture film can be prohibitive, so the FADGI-DMPF provides a discussion and sample Statement of Work for vendor outsourcing. Refer to [NARA Digital Moving Images from Film-based Source Material](#) for quick-view input and output specifications.

## Digital Reformatting File Specifications

Container formats and codecs vary. Refer to Section 3 “Inputs and Outputs” of the [FADGI-DMPF](#) for a discussion of container format and codec selection for digital reformatting in multiple contexts. In a preservation context, lossy formats are not recommended. Uncompressed (e.g., v210, DPX) or Lossless (e.g., FFV1) are recommended codecs, while container formats may vary depending on institutional requirements for embedded metadata (e.g., .mov, .avi, .mxf, .dpx).

The [FADGI-DMPF](#) provides recommended “outputs,” or preservation file formats, in the classes of High Definition digital video and “DPX image+audio” which translates to DPX imagery and sound bundles. Example inputs, or classes of motion picture film such as a negative or positive, are provided in addition to examples of soundtrack inputs. For quick-view input and output specifications for other classes of motion picture film like Optical and Magnetic Sound Tracks, refer to [NARA Digital Moving Images from Film-based Source Material](#).

NARA delineates between 35mm film/16mm Kodachrome and All Other 16mm Film in order to illustrate the necessity for choosing 4k and 2k output resolutions respectively. The most ubiquitous motion picture film format in the UC System is 16mm. While 4k is the standard resolution for 35mm scanning, choosing between 4k and 2k for any 16mm input (even Kodachrome) will require a consideration of institution specific data management capabilities. NARA quick-view input and output specifications for one of the 16mm classes are adapted in the table below for reference in this section.

All 16mm elements aside from Kodachrome with or without optical sound<sup>7</sup>

File Properties

<b>Data Format</b>	<p>The capture process may result in two separate files linked by metadata.</p> <p><u>Image Data</u></p> <ul style="list-style-type: none"> <li>• DPX (Digital Picture Exchange) as defined by SMPTE 268M-1994</li> <li>• Uncompressed</li> </ul> <p><u>Audio Data (if present)</u></p> <ul style="list-style-type: none"> <li>• Broadcast WAV (.wav) as defined by The European Broadcasting Union in document Tech 3285</li> <li>• Uncompressed</li> </ul>
<b>Capture Information</b>	<p><u>Image Data</u></p> <ul style="list-style-type: none"> <li>• Bit Depth: 10 Bit</li> <li>• Resolution: 2K (2048x1556)</li> <li>• Color space: 4:4:4</li> <li>• Color model: RGB</li> <li>• Byte order: Big endian</li> </ul> <p>Typical file size: ~ 17 GB/minute or 1 TB/hour</p> <p><u>Audio Data (if present):</u></p> <ul style="list-style-type: none"> <li>• Encoded to Linear Pulse Code Modulation (LPCM)</li> <li>• Sampling frequency: 96 kHz</li> <li>• Bit depth: 24</li> <li>• Sound field: mono or dual mono</li> </ul> <p>Typical file size: Mono: ~ 17.28 MB/minute or 1 GB/hour; Stereo: 134.5 MB/minute or 2 GB/hour</p>

**Quality Assurance and Quality Control**

Quality Assurance ensures proper creation and delivery of target preservation file formats while Quality Control ensures the integrity and faithfulness of a target preservation file format to its source. Refer to the FADGI-DMPF discussion on “Workflow, Scanning, and Other Specifications” for a discussion of quality assurance and control. NARA also recommends verifying technical characteristics such as Frame Rate, Resolution, Resolution Change, and RGB Color Gamut. Utilize available tools for like [qctools](#) and [mdqc](#).

<sup>7</sup> Adapted from <https://www.archives.gov/preservation/products/products/mpd-p3.html>

Example: Verify that digital file outputs for preservation match the original motion picture film frame rate and aspect ratio.

### **Metadata**

[FADGI-DMPF](#) addresses technical, preservation, and ancillary data associated with the target preservation file format. It should be assumed that reformatting hardware and software generate the appropriate technical metadata concerning picture and sound within the target preservation file format. Other common types of preservation and ancillary data may include process history and time code. It is not always the case that this data can be embedded in the target preservation file format, therefore sidecar files may be preserved alongside preservation files. Determine your institution's requirements and means of preserving metadata, and refer to the discussion "What metadata ought to be provided to a contractor, what metadata ought to be requested in the Statement of Work?"

Example: Provenance metadata such as format, gauge, length etc. is considered ancillary data that can be preserved as embedded metadata in the target preservation file format or sidecar files to be included in a digital object for preservation.

### **Accessibility**

Web Content Accessibility Guidelines (WCAG) outline a set of recommendations for making Web content accessible. It is recommended that UC campuses and campus groups consider the [guidelines for Time-based media](#) when strategizing ancillary data for preservation and access.

Example: Subtitles can be utilized by video players to make video accessible. Encoded text can be converted to [SRT files](#) as part of your digital object to preserve, either embedded or saved as a sidecar file with your target preservation file format. Such a file can be used to display optional subtitles in the video.

### **Glossary**

The U.S. National Archives and Records Administration (NARA) provides a helpful glossary of terms found [here](#).