

# HIGH DEFINITION FORMAT GUIDE

A working tool for FootageBank HD clients

## HD FORMATS

Format	Resolution <small>(pixels x lines)</small>	Frame Rates	Scanning Mode	Recording Formats & Compression	Color Subsampling*
<b>1080p</b>	1920x1080	23.98 → 25 → 29.97 → 24 →	Psf Psf Psf Progressive	HDCAM - 4:1 D5 - 4:1 HDCAM SR - 2:1	→ 8-bit 3:1:1 → 10-bit 4:2:2 → 10-bit 4:2:2 or 4:4:4*
<b>1080i</b>	1920x1080	29.97 → 25 →	Interlaced Interlaced	HDCAM - 4:1 D5 - 4:1 HDCAM SR - 2:1 DVCPRO HD - 7:1	→ 8-bit 3:1:1 → 10-bit 4:2:2 → 10-bit 4:2:2 or 4:4:4* → 8-bit 4:2:2
<b>720p</b>	1280x720	23.98 → 25 → 29.97 →	Psf Psf Psf	D5 - 4:1 DVCPRO HD - 7:1	→ 10-bit 4:2:2 → 8-bit 4:2:2
<b>HDV</b>	1440x1080	29.97 → 25 →	Interlaced Interlaced	MiniDV HDV** - 27:1	→ 8-bit 4:2:0
<b>HDV</b>	1280x720	23.98 → 25 → 29.97 →	Psf Psf Psf	MiniDV HDV** - 27:1	→ 8-bit 4:2:0

▶The aspect ratio for all HD formats is 1.78:1 (16x9).◀

\*All listed formats are compressed. Uncompressed 4:4:4 is achievable only when recording via HDSDI to an external HDD.\*

\*\*HDV also records to flash memory cards and on-board HDDs using the MPEG-2 codec.\*\*

## NEW FORMATS TO WATCH

**Data Cameras** capturing uncompressed 10-bit 4:4:4 to HDDs with resolutions currently up to 4520x2540 (aka 4K) and in the near future 6K. Such cameras now in production include: **Panavision Genesis, Sony F23/F900R, Grass Valley Viper, Dalsa Origin, Arri D-20, and RED One.**



# HD TERMINOLOGY

**Resolution:** The number of pixels along a horizontal line drawn across the width of the frame versus the number of scan lines that go across the frame as counted along a vertical line drawn from the top to the bottom of the frame. In HD, 1920x1080 or 1280x720 are the standards.

**HDCAM SR:** A tape format that uses a higher particle density tape and is capable of recording in 10-bit 4:4:4 RGB at bitrates up to 880 Mbps.

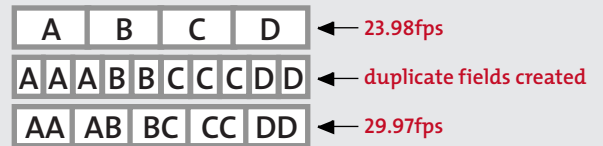
**HDV:** Although "HDV" shares many properties with "HD," the form of compression in HDV cameras (not the compression ratio) limits the acceptability of the format. HDV employs inter-frame compression while the other formats (with the exception of XDCAM) employ intra-frame compression. Inter-frame compression can result in motion artifacts, especially in fast-moving subjects, and can lead to noticeable dropouts during processing in post.

**Color Subsampling:** (aka colorspace conversion, chroma subsampling - 4:4:4, 4:2:2, 4:2:0, 3:1:1, etc.) The conversion from a "digital colorspace" (RGB) to a "video colorspace" (YCrCb) to assign more bandwidth to the green or "brightness" component of the signal (represented by "Y"), and to assign lesser bandwidth to the red and blue "color difference" signals ("Cr" and "Cb"). This takes advantage of the human eye's greater sensitivity to detail in bright (predominantly green) light. In HD, the highest or "full bandwidth" sampling frequency is 74.25 Mhz. In these color subsampling ratios this frequency is arbitrarily denoted by the number "4." For example, 4:4:4 has a maximum colorspace for green, red and blue and 3:1:1 has less than maximum in green, red and blue.

**HDD:** Stands for Hard Disk Drive. These drives can live separate from or be mounted on-board cameras.

**3:2 PULLDOWN:** For every 4 frames of 23.98fps material there are 5 frames of 29.97fps material. In a 3:2 (aka 2:3) pulldown, alternately three then two fields are extracted per frame.

## 3:2 PULLDOWN



## SCANNING MODES



**PsF**

(progressive segmented frame)

A format used to store progressive content on interlaced media. Each frame consists of two segments (or fields), one with odd lines and one with even lines, but each field contains an identical image so that the image moves at the frame rate.



**i**

(interlaced)

Two fields, each unique, but one with odd lines and one with even lines, comprise each frame. Each field captures motion at different points in time so each field is different.



**p**

(progressive)

Every digital frame is unique and contains a complete image. The frames advance without overlapping or blending at frame rate. Progressive imaging best imitates film.

## COMMON HD CROSS-CONVERSION ISSUES

### i to p (interlaced to progressive or PsF)

Since each field is different, artifacts in the motion are introduced upon deinterlacing. Deinterlacing can create issues such as temporal artifacts, judder or stuttering, especially if there is significant motion in the shot. Even if there is no change in frame rate such as with 50i to 25p, artifacts may result.

### p to i (progressive or PsF to interlaced)

Converting any progressive format to interlaced is generally acceptable aside from frame/field rate issues described next.

### frame/field rate changes

All frame/field rate conversions from a film-type rate such as 23.98 to a video rate such as 29.97 will require a 3:2 pull-down to be added which may minimally affect the motion, but which remains the industry standard solution to converting film rates to video rates since the invention of 30fps video. Converting the HD equivalents of PAL (50i or 25p) to or from 23.98 or 29.97 will result in a running time that is slightly shorter or longer than the original content.

## HD-TO-SD CONVERSIONS

HD can be easily down-converted to standard definition. However, the inherent 16x9 aspect ratio of HD must be reduced to 4x3 using one of the following processes:



### Edge Crop

Also called center cut. Crop the image on the right and left sides of the frame so that it fills a 4x3 frame.



### Letterbox

Frame the image with black on the top and bottom so that the full width of the picture is visible.



### Anamorphic

Squeeze image so that it can be unsqueezed and cropped or delivered in a non-HD 16x9 format.

## FOOTAGEBANK HD DELIVERABLES

### Tape Masters

*Recommended for orders of multiple shots.*

- ▶ HDCAM SR: 1080i or 1080p
- ▶ HDCAM: 1080i or 1080p
- ▶ D5: 1080i, 1080p or 720p
- ▶ DVCPRO HD: 1080i or 720p (these tape decks do not record at 1080p)

### Digital Files

#### Format Options:

- ▶ Uncompressed HD digital delivery recommended options:
  - a) HD resolution QuickTime movie file (.mov) using an uncompressed 10-bit codec with millions of colors and 4:2:2 color sampling
  - b) HD resolution TIFF or TARGA image sequence

*[Uncompressed HD files will be approximately 150MB per second depending on various factors, making a 10 second clip 1-2GB.]*
- ▶ Compressed HD or Standard Definition digital delivery recommended options:
  - a) HD or SD resolution QuickTime movie file (.mov) using the H.264 (MPEG-4) codec with millions of colors and a 4:2:2 color sampling. *[Any other codec can be specified.]*
  - b) SD resolution TIFF or TARGA image sequence

#### Delivery Options:

- ▶ **FTP upload:** Not recommended for shots that are longer than 20 seconds or for multiple shots. Download times will vary depending on downloader's internet speed (T1 or faster is recommended), traffic and processor speed. HD .movs will require uninterrupted time of as much as 1-4 hours per 10-second clip. HD image sequences can be interrupted but will require as much time as .movs and will need to be reassembled.
- ▶ **DVD-R:** .movs or image sequences can be loaded to data DVDs. Not recommended for multiple shot orders of true HD material as only 20-30 seconds of uncompressed HD will fit on one DVD-R.
- ▶ **HARD DRIVE:** A FireWire hard drive can be provided by client for files to be loaded. Recommended over FTP or DVD for multiple shot orders, or a tape master for large orders may be more efficient.



# FootageBank HD

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