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 High Definition 24P is not film, and it will not replace film. High Definition will fit some products. In some productions High Def will be the choice medium. However, some projects should not consider High Def. Just as you consider which Film Stock to shoot and whether or not to go location or stage, HD24P is only of value where it fits. Creating a good HD24P project is subject to the same rules as creating a good film project and does not throw out all of the lessons that have been learned producing on film over many decades, but adds functionality that only a digital medium can provide. 24P has many of the characteristics of film and has some characteristics that are not in film. It still comes down to block well, light well, and frame well.

High Def comes in many forms:

The resolution of HD is referred to in the number of horizontal lines on the screen. Standard Definition video comes in one flavor which is 525 horizontal lines. High Definition comes in two sizes – 720 and 1080. The larger the number, the more data available. 1080 records 1,080 lines in height with 1,920 pixels in each line for a total of 2,073,600 pixels in each frame. 720 refers to recording 720 lines in height with 1,280 pixels in each, or 921,600 pixels. Both are high Definition, two very different standards. High Def has six times the data, and 20% more picture than current video, the end results are breathtaking.

The next consideration is in what order the pixels are projected to complete the frame, this is the scanning pattern. Television pictures are scanned at a very high speed to trick the eye into thinking that the picture is continuous and seamless, and that the motion is smooth and lifelike. Essentially, a series of still pictures is 'painted' onto the screen line by line.

There are two ways in which scanning takes place:

Interlaced scanning - In interlaced scanning, all the odd lines are scanned first (1,3,5 etc) followed by all of the even lines (2,4,6 etc). This effectively 'paints' half the picture (a 'field') in one scan, followed by the other half in the next. This system was invented many years ago to reduce the bandwidth needed to retransmit the picture.

Progressive scanning - In progressive scanning, each line is drawn sequentially (1,2,3,4 etc). Depending on the system, this either occurs 24 or 30 times per second, or 60 times per second. For a given number of lines and pixels, progressive scanning at 60 frames per second, takes exactly twice the data transmission rate as interlaced scanning at 60 fields per second.

All analog TVs use interlace scanning. Virtually all computer monitors use progressive scanning. Progressive scanning generally is more suitable to display detail such as text, and removes some of the artifacts associated with interlacing (such as 'twitter' and sharp edges), but requires more bandwidth for transmission.

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The third element in HD formats is frames per second. That's where you hear the 24, 23.98, 30, 29.97 etc.

All of this so we can identify what we are doing in HD by this combination of letters and numbers. 1080i generally means they want 1080x1920 resolution, interlace scanning with a frame rate of 29.97. If they ask for 24P they could be either asking for a 1080 resolution shot at 24fps progressive scanning, or 1080 resolution shot at 29.97fps progressive scan, or they could be asking for either 24fps or 29.97fps in 720 resolution. So we often have to ask twice to ensure we set up the camera correctly. In some ways we have almost too much information, and that can complicate the process. However, with a little more information, we will get it right.

The majority of the time we would always go with the recommend what is going to give you the most digital information. But there is a large value to the artistic differences as well. The Varicam is able to capture at relative fps from 1fps to 60fps because of the reduction in resolution and increased compression, but that ability may be valuable to the artistic demands of the shot.

To know which way to go, the first consideration is to attain the required broadcast specs. The majority of my experiences in commercial production require the product to be delivered in Digibeta format. Industrial productions favor delivery in DV or DVCam.

If it is to be delivered finished in HD, the majority of the time I have been asked to deliver in 1080i format. 1080i is short for screen resolution at 1920 X 1080 interlaced with the frame speed at 59.94i. While Panasonic is promoting 720P it does seem like there could be a fair work around for the short term, very few stations have expressed any interest in this format.

Now even though you are going to deliver 1080i, you do not need to shoot in 1080i. You would make the choice in film speed and shutter angles in HD as a creative option just as you have in film. The transfer from 1080/24P to 1080i is very simple and low cost. That's covered later.

Shooting Recommendations

We refer to 24P but it is recommended to shoot "23.98P" not "24P." Broadcast standard is 29.97 and the downconvertion from 23.98 to 29.97 is better math then trying to convert from 24fps. For that same reason use "29.97" not 30 and shoot at 59.94 not 60i

Never, ever, ever record multiple frame speeds on a single record tape. This plays havoc in post. If you absolutely have to do it, run a minute or two of bars on both sides of the break.

Setting frames per second does default the electronic shutter, but it can be changed inside your menus. The camera set at 24P, and the electronic shutter set to ON at 1/48th equates to a 180° shutter. Setting the shutter OFF, increases blur in motion equal to 24 FPS at 1/24th. Every frame per second (FPS) setting defaults to a shutter value half of the FPS setting. As well as being able to shot up to 1/2000 of a second, you can also set the shutter to Extended Clear Scan. This ECS setting is designed to sync the camera to television monitors and/or computer screens.

When shooting HD, you frame inside a wide, 16x9 screen. If your final product is going to be delivered 4x3, decide if you are going to deliver letterboxed or edge cropped. The camera operator needs that determination to know weather or not to protect for full 16X9 even though his primary framing considerations is for NTSC TV Safe. With the Miranda Camera Back you can display to your video assist the frame markers as well as time code and slate information.

If you want to help out your editor and maybe save a buck or two, it is recommended you label tapes with a 4 character numeric series; example: 0001, 0014. You should also match the time code hour with the tape number; start with 01:00:00:00.

Running time of HD Tape is 50 minutes at 23.98 even though the box will say 40 minutes (40 & 22 minute tapes are available for field use). Running time at 29.97 is 40 minutes.   Average Cost of 1 HD Tape is $65.00. 1 HD tape equals 3,200 ft of 35mm film run time.

The true savings is in HD tape vs. rolls of film stock purchase, plus processing and plus transfer. High Def camera packages rent for about the same as 35mm film packages. Where they can be more expensive is in how extreme you want to be with monitors and measurement equipment. It is not supported that High Def can save budget dollars in crew and personnel. The same number of crew in every department is necessary to do the level of quality you expect on a film set. On multi camera shoots it may be necessary to add an HD Engineer.

This may be a good time to run an example film to HD comparison I found on the net:

Compare: all 3 formats for 40-45 minutes of edit ready footage...

16mm film production ...

16mm film stock (4 - 400' rolls) (44 total minutes, less if high speed) $580.00
processing $275.00
telecine 1.5 hours @ $400.00/hr + or - = $600.00
tape stock (1 hour digibeta) $ 85.00
$1540.00 total for 44 minutes worth of 16mm film footage

35mm film production...

35mm film stock (8 - 400' rolls) (approx 40 minutes, less if high speed) $1536.00
Processing $576.00
telecine 2 hours @ 500.00/hr + or - = $1,000.00
tape stock (1 60 minute digibeta) $85.00
$3197.00 total for 40 minutes of 35mm film footage

24p hd production...

HDCAM hd Stock (1- 45 min. tape) $65.00 (same length if high speed)
HDCAM portable deck to playback for digitize $300.00 / day
Digibeta portable deck to record for digitize $300.00 / day
tape stock (1 hour digibeta) $ 85.00
$750.00 total for 45 minutes of 24p hd footage

On the subject of "Digital Image Technicians" and /or "HD Engineer" and weather or not to hire one, you have to go with the experience of the rest of the team. Between the Director of Photography, Gaffer and Camera Assistant you may already have the experience and knowledge base to control the production. Measure up the project with this team to make that call. We generally do call for a Digital Image Tech if it is a multi camera shoot.

HD does not require less skill in lighting. The artistic skill of a lighting team is not replaced by the technology. The placement of a key source or the justification of scene lighting demands the same ability as a film production. HD measured in terms of shadows and highlights are in fact a tool to be controlled by the blend of technical and artistic skills. High Def exposure sensitivity is considered to equate to 320 ASA.   For best performance it needs just as much light in quantity as if exposing 320 ASA Film. In terms of quality, that is strictly an artistic judgment.

HD exposes like color reversal (Slide film rather than negative) you could also note that all the menus imply color reversal as a percentage. A scale of +20 means 20%, +50 means 50% and going to the negative numbers refers to increasing percentage –50 is 150%.

HD has less latitude than film, on the F900/3 it is about 6 stops, 4.5 Under and 1.5 Over. On the f900/2 it is less. You can push this 2 stops or more when you start getting adventurous with the paint and maintenance menus. HD has much more bottom end in the blacks than top end in the highlights, most advice goes to under expose rather than over expose. This is especially true if you are taking it to a DaVinci or Pandora.

Utilizing the paint box and the menus, you can virtually get timed dailies on the set. It is imperative to know if you are going to transfer deck-to-deck for downconvertion or if you are going to a device such as the Pandora, or if you are finishing in HD. Each post method has different characteristics that you can play into to get the best results. Deck to Deck generally picks up a slight amount of contrast and a certain degree of color shift, so as a technician I would underexpose by a 1/3 and open up the blacks just slightly. Exposing for the Pandora or DaVinci would offer the greatest contrast and color range. The thing about paint boxes though, leave them alone until you are ready. Also have a safe, record-locked, backup memory stick with your start up setup, just in case all that creativity runs a bit off course.

HD is Tungsten base so ND and Color correction filters are built into the camera. The ND wheel is marked with _, 1/8 , 1/16 and 1/32. Equated to the familiar ND rating, that would be ND.6 ND1.2, ND2.4 respectively. Electric Light & Power has replaced the standard set of Sony ND filters with a set from Harrison & Harrison for better control. We have also upgraded the color filters to Harrison & Harrison filters.

Know how to properly set the Back Focus or your images will be soft. On thing we keep hearing about is how difficult setting and keeping the back focus of the lens constant. This can not be further from the truth. While there are systems that are plagued by this, The F900/3 change from prime to prime is less than one minute and from or to a zoom in maybe two if we are taking our time.

In most cases back focus can be guaranteed at checkout, and can be verified out on location with the use of a Zeiss Sharp Max in less than a minute. If you are setting back focus with a chart, use the shutter and/or the ND filters to expose the lens at wide open. Turn peaking and contrast up and brightness down on your monitor. Set the camera at about 7 feet for standard lens sets or 4 feet with a wide angle lens. Zoom in and focus on back focus chart. Zoom out wide and adjust the back focus until sharp. Reset stop, shutter or Neutral Density wheel, and viewfinder.

 The fastest and most simple method of back focus I could ever recommend is the Zeiss Sharp Max. The Sharp Max is attached to the front of the lens (while mounted on the shooting camera). Set the lens focus scale to the mechanical infinity limit and adjusts the back-focus ring for the best visual resolution of the star image in the camera viewfinder or on the monitor. Lock the back-focus ring, remove the Sharp Max from the lens, and get back to work. The full procedure takes less than 30 seconds.

Shoot Record run Timecode even if you do multiple cameras. Cameras do not need to match TC for post to sync it up. It creates more problems than it's worth to shoot Free running TC. Definitely talk to your edit house before taking this advice though, there are many truths in HD and many different methodologies, let the guys doing the work make the call.

CAMERA SET UP

The RMP-150 paint box is recommended, an advanced operator may enjoy using RPM-700 which is LCD touch screen that is fast and easy to use. The strong point to the paintbox is being able to rapidly adjust the setting controlling your color, contrast and sharpness. The most effective areas to balance are the knee and the gamma and black gamma.

The knee is a great tool in expanding and/or controlling the contrast range for a given exposure. Caution, however, if you bring the knee down to far you will start to affect color saturation especially in skin tone. In addition the whites will become gray.

Effective changes in gamma will change the relative gain in the blacks and whites and so could help to equalize a radical difference and the black gamma control can further stretch the blacks more than the whites to help out. Adjusting the matrix with the paint box menus, can be extremely helpful in controlling your image. However don't forget that gain, gamma, black gamma and detail all affect the video noise in the image and noise can be a significant problem. Watch closely for errors and artifacts in the blacks and along the edges of whites. This is the main reason for having a least one fairly good size monitor around.

Special Considerations for Sound

For good measure, it is good practices to not only record the master sound on HD Tape, additionally record to an external recording device (which should be running at 29.97 NDF). By shooting this duel sound method, production will save money by skipping timing and syncing of dailies, create a permanent synced source and will give the producer the peace of mind of a separate source.   Be aware that to hear the sound coming from the HD camera you need a 5 pin

XLR for discrete Ch-1 and Ch-2 return. To record to tracks 3 & 4 you will need a Miranda Conversion Back or similar accessory. Money may be a good reason to single record on the HD Tape. Do what you have to do to make the budget.

For the off camera source, weather you chose to record on Nagra, DAT, DA88 or DEVA. Use 29.97 NDF (Non Drop Frame). Using a Time code slate is helpful with TC removing a dependency and transfer error that can easily happen. Have a timecode slate that is displaying the timecode of the external audio recording device. At the beginning of <u>every</u> take, show this slate in the frame so that the time reference can be manually read off and used to lock audio in post.

In addition, if circumstances allow, clap the sticks as always. Some sound mixers feed time code into an available channel of audio on the camera with a Deneke Brain. Its wireless and provides a permanent source of sync for the external sound recording device.

It is highly advised to match the rates of the camera and audio device. If the camera is 24P, the audio device should be 30 frame Non-drop timecode. If the camera is 23.98P, the audio device should be in 29.97 Non-drop frame.

The biggest issue with the post houses is broken timecode. Setting the camera to "Record Run" will solve a lot of problems for the guys in the dark rooms. This means that you can't just 'Jam' the timecodes together and let the devices free run.

We do have the capability to take the timecode of the camera and run it into a down converter or timecode translator. The converted timecode is then fed into and recorded on the audio device. What this does is convert the 24 frame timecode from the camera to 30 frame time code on the audio device.

Whenever Power is broken like changing the battery or tape is taken out and put back in, it is necessary to perform a match frame edit to prevent a break in control track. This is called reracking. Push RET button behind Zoom rocker on the ENG lens or Assignable Toggle on side (Adjustable via Menu) LENS RET Set switch under Advance button to REGEN* TC will pick up where it left off automatically.

Here is a short step by step to start the day:

- ❏ Attach Battery or AC Power supply.
- ❏ Power up the Camera (ON OFF switch)
- ❏ Push eject button on top of the camera under the handle.
- ❏ Insure the record inhibit tab (little red square) on tape cassette is flush with edge for record. Place tape in Camera. Orange Door to the front and sprocket holes to the smart side.
  Slowly press door closed
- ❏ Set Frame Rate (do this before you send bars because some monitors may need to be reset to match the frame rate).
- ❏ Set DCC to Color Bars and run around to all the monitors having one person make the call adjusting all the monitors to a standard look
- ❏ Set Timecode
- ❏ Set Proper color correction and ND for light being used.
- ❏ Set DCC Dynamic Contrast Control ON (maximizes separation of highlight distinction).
- ❏ Set Shutter Speed to ON and Insure it is at 1/48th =180° Shutter Angle. A lot of people like to shoot with the shutter off, this is an artistic call.
- ❏ Insure all necessary cables are plugged in.
- ❏ Set camera on Color Bars, ask for Tone from Sound.
- ❏ Push VTR (record) button to start recording and roll for 30 seconds.
- ❏ Push VTR button again to stop recording. Tell sound you are "Clear"
- ❏ Set Proper Eyepiece Adjustment. Leave the camera on Color Bars and turn Contrast on the viewfinder down 1/4 turn, Set Brightness till rightmost black bar is barely visible, some people match the darkness of the outside edge of the viewfinder.
- ❏ Set your Save/Standby switch. Save-takes 7 seconds to record, Tape is off the head, this is great for head wear and tear. Standby-takes 1.5 seconds to record, Tape always sits on the record head. This gives you a much faster on the draw, but will wear the head and the tape. Let the flow of the day dictate this setting. Either way you should record for a few seconds before calling Speed, Marker, Set, ACTION.
  This will always insure enough Preroll to use the footage shot (like necessary leader) for the editor
- ❏ Now you have a picture and are ready to hand the camera over to the Operator or DP to frame up the first shot.

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Onset Monitors, Video Assist and All the Other Stuff you Have to Plug In

Describing with all the variables would be like publishing an encyclopedia. So I am certainly going to skip over some possibilities and layout one setup that has worked well.

The Sony F-900 exports the image in an analog component HD signal and the audio through a 5-pin XLR. With accessories from manufactures like Evertz and Miranda we can output in HDSDI and Component NTSC. Miranda's DVC-800 will also export via Firewire. So there is a huge variety of possible monitor scenarios.

Downconverting

You don't need to offline in HD. That would take a great deal of storage. The most success we have had is to down convert your dailies to footage to DigiBeta, Beta SP, DV or DVCam and offline conventionally. With the Miranda back on the camera we can actually record direct to hard drive as we shoot, and the client can walk away with the dailies or even use this as video playback. We have had problems exporting an offline EDL created by Final Cut into Avids, but there is a work around. There is a great program called Automatic Duck. Automatic Duck's solution for translating the Final Cut Pro timeline into Avid editing systems employs OMF, an interchange format developed by Avid Technology. The offline developed can be used in an AVID or even a Cinewave or KONA edit system to capture select full resolution HD. Editing of dissolves, CGI, Slow motion effects and titling can all be done in the final HD Online session to create a final HD master. We will convert your video and make sure that timecode is translated properly as the guide that will be used later in the online session. We recommend getting your down conversions in a letterbox format with both the 24 frame and 30 frame timecodes window burned below the picture. This allows for the offline editor to make sure that the entire frame is acceptable for use in the finished 16x9 master, and gives a visual reference on the offline master that can be used in the online session later if there are any problems with the EDL or OMF.

Spend your creative time working in the non-linear environment. Because you can use a standard definition non-linear system, it allows you to spend more time getting it right. It is cheaper and faster to do your creative work this way than off lining on a High Definition non-linear system. Take the down converts and digitize them into your non-linear editing system. You can offline as either a 24 Frame project or as a standard 30 frame video project, what ever fits your post system.

Once your shot decisions are finalized, take the sequences that you will be doing effects work for (Compositing, Slow-Mo, etc) and get them made. Once you have them done, make a HD effects reel, have it down converted, and insert these new shots into your offline. This allows for everything to be timed right in the online session. This is also a

good time to output a sample OMF and send it to the Avid so that any potential problems may need to be addressed.

Use the Effects Reel down convert to replace the original shots in the sequence. Once everything is finalized you should output an OMF for the online. Output the show from the non-linear system onto tape to bring to the online session. This gives you a visual guide to refer to in case of problems during the online edit. Also you then have a scratch audio track to put down on the master.

Online

Bring your Camera Reels, EDL or OMF, and offline Cut.

Once you have your HD master edited, color corrected, titled, and the audio inserted, you have completed your project. Then make duplicates and deliver your program in NTSC, PAL, 1080/60i, 1080/50i, or 1080/25P. The HD master can also be printed to film. All lists and effects are put on disc and enclosed with the masters for future revisions or rebuilds.