

# *JOE KANE PRODUCTIONS*

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## A Video Standard - Index w/ Notes

12 July 2004

### Program Chapter & Frame Index w/Notes

#### Introduction

This index lists program topics in the order of their location. Individual topics are often many frames long; therefore not all frame numbers are listed. There are three additional alphabetical indexes found in subsequent sections of this book. Audio test signals are in the "Audio" section. Video test patterns have been listed in the "Video Test Signals" section. Program elements, often contained within a particular topic, are listed in "Program Elements".

This disc begins at CHAPTER ZERO, Frame 1.

Location:      Information:

1	Reference Recordings Presents
525	A Joe Kane Video Production

#### Video Control

CHAPTER ONE: "Video Control"

Dolby Surround Sound2 Encoded

The program opens in the Video Control Room, a point where all of the elements of video come together. The Grass Valley Model 100 production switcher is shown as the device that selects each source, one at a time, that make up the remaining program content of the disc.

634	"A Video Standard"
705	Video Control

The control room video was shot with Broadcast Television System's (BTS) LDK-90, 3 Chip, CCD Camera. The camera's analogue RGB outputs were connected directly to the Sony D1 recorder.

1010	Color Bar Animated Sequence
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2215	CHAPTERS 1-4 Index (Picture Stop)
2216	CHAPTERS 5-7 Index
2217	Player Functions

The animation in this sequence originated by combining elements from two different video graphics systems. The 2-D foreground was constructed in the Quantel Paint Box while the 3-D background was put together in the BTS FGS 4000 Graphics generator. The two elements were combined in the Quantel Harry before being recorded directly to the component digital D1 format. The animation is mixed field dominance, with the background starting on field one, and the foreground starting on field two. This feature provides background motion while advancing thru the animation one frame at a time.

There are 30 individual pictures per second in this sequence. As a result, the motion detail is much better than found in most cartoon material. (Animation is normally done at 12, 15, or 24 pictures per second.)

## Studio Video Production

### CHAPTER TWO: "Studio Video Production" Dolby® Surround Sound Encoded

One of the most basic elements of television is studio based programs with images captured by one or more large (studio) video cameras. News and daytime television programs are often shot this way. The example here has been taken from the set of a morning talk show at a television station on the East Coast. A condensed version of the setup routine, that would take place prior to program production, is demonstrated. While not being covered in any detail, stage lighting, camera alignment and placement, and audio are all important.

A single Philips LDK-6 camera, one of the three normally used on this set, was used to shoot this sequence. The camera's NTSC video output was recorded on a Sony D2 composite digital recorder. Video in the control room was shot using the BTS LDK-90 and recorded directly to D1.

2218	"Studio Video Production"
2413	Lighting

This lighting system can be programmed to control the amount and sequence of stage lighting. The lighting director will pre-stage a program, often using marks on the floor to let the performers know where they must be positioned during the show for the lighting to function properly. Similar systems are used in motion picture and live stage productions.

3302	Camera Registration
3699	Chip Chart, camera gray scale
3797	Video system timing

Most studio cameras capture an image in three colors, red, green, and blue. (See Figure 1.) Those three images must be exactly registered in the final video output of the camera if a proper image is to be presented on the video monitor. The LDK-6 has automatic registration. A checkerboard pattern is placed in the lens system as an image. The computer in the camera manipulates each of the red, green, and blue video channels until they exactly fit together.

One of the most important parameters in producing a good color picture is the ability of the camera to make all neutral (gray) elements in a scene look gray, (no color). A Chip Chart, a test chart containing a series of gray patches, is placed on a properly lit set in front of the camera. With the camera looking at the Chip Chart, the red, green, and blue signals are adjusted to produce an NTSC signal that has no color information, only black & white.

Once the individual cameras are properly adjusted, their picture timing is set so that they exactly coincide with each other as they arrive at the production switcher. This is done by matching the color bars generated by each camera to the house system color bars.

4015        Camera placement in the studio  
4118        Production Switcher

The program director will decide where the cameras are to be positioned to capture the desired image. The on-stage talent knows which of the cameras is being used for the on-air image by a tally light indication on the selected camera. The production switcher, which is used to choose the out-going image, controls the tally lights on the cameras.

4458        Studio Audio Check

Tapping on microphones is not normally advised.

(Still Frame Sequence):  
5059        Initial Set of Video Test Patterns

See Video Test Signal Identification Notes Following the Program Index:

The test signals in this section are intended for evaluating the disc's system performance at the inside diameter of the disc. Test signals provided in Chapter Seven should be used for system evaluation. The test signal frames at the end of the Chapter Two lead directly into the still frame sequence of Chapter Three.

Electronic Field Production

CHAPTER THREE: "Electronic Field Production"

Electronic cameras for taking and recording video images are beginning to approach the versatility once held exclusively by film cameras. The first application for the "portable" camera was Electronic News Gathering (ENG). As camera quality improved, Electronic Field

Production, (EFP) evolved. Today, some of these "field" cameras are good enough to be used in studio video production.

(Still Frame Sequence):  
5074 "Electronic Field Production"  
5075 Betacam Field Production System  
5081 Press "PLAY" to continue  
  
5105 "Electronic Field Production"  
5409 Field Production Team  
5478 Camera Configuration

This insert shows how the two camera/recorder combinations were mounted for a raft run on the American River in Northern California. A similar camera separation and angle was used on the helicopter mount in the sequence that follows.

5645 Flight to the Ridge of the Canyon

Approaching the ridge, the image from the left camera is shown first and then the image from the right camera. The picture continues to shift between the two images to emphasize that there are two full video pictures. They are used as elements of the next sequence.

5904 Opening to Wide Screen Video

This section presents a single picture made up of the two video outputs of the side by side Betacam's. The two cameras are positioned so that the right edge of the left camera's image just overlaps the left edge of the right camera's image. The angle between the two cameras is rigidly controlled. All left, right, up, and down movement of the two cameras are done to the camera mount.

In post production, each video image is reduced to 1/4 of its original size, placed next to each other, creating an 8 by 3 aspect ratio picture. The resulting wide screen video is wider than the proposed aspect ratio for future high definition television systems (16 by 9). The two full video images were reduced and combined by the Grass Valley "Kaleidoscope" Digital Effects System. The component output of the "K-Scope" was transferred to D1.

There are slight differences in the image quality between the two cameras. It is particularly noticeable in the dark areas of the picture. In addition, the lenses on the cameras slightly distort the picture. This visible line between the two images is a result of that distortion.

This sequence is not an example of the early stages of evolution of High Definition TV, but a demonstration of our field production crew being creative with EFP.

The current full screen television aspect ratio is 4 by 3, which evolved out of an early 35 mm motion picture format. Just as the motion picture industry went wide screen, television will also, someday, go to a similar wide screen format.

11250 "Starflight 1" Music credit

## Transferring Film to Video

### CHAPTER FOUR: "Transferring Film to Video & Audio Demonstration"

Sourcing program material from film is very popular in television production. Over the last 20 years approximately 80% of network prime time programming has originated on film. High quality film to video transfer devices, such as the Rank-Cintel (Rank) film chain, have played a large part in keeping film in its current position of popularity for program production.

Note: Once the opening sequence of this chapter is completed, the analogue and digital audio tracks become independent of each other, with both audio tracks independent of the video. This separation continues to the end of Chapter Five. Dolby Surround Sound Encoding is also shut off during this period.

11295 Beginning of Chapter Narration  
11387 Chapter Four Title Frame  
(Still Frame Sequence):  
11388 Flying Spot Scanner Film Chain

A brief description is provided about how the Rank Cintel film chain converts a film image to a television image. The final frame of this sequence illustrates how 24 frames per second film is transformed into 30 frames per second video. The transformation takes advantage of the fact that there are 60 half pictures per second in video. (See Chapter Five: the Basic Television section.)

Continue to step forward through the program one frame at a time:

Note that the disc is only stopping at film frames. A special code has been placed in the disc's vertical interval so that frame counts are advancing 24 times for each second of real time rather than 30 times a second for video material. This function allows film to be accurately studied frame by frame, without the problem of the 24 frame to 30 frame conversion.

At some point, while going through this disc, look at this same material as it is used in Chapter Five: Frames 16745 - 16782 in particular. No attempt has been made to correct the still frame stop points for the 24 frame film rate in that video. Return to the beginning of the opening film count down, listed below, and press "PLAY".

11397 Print Film Count Down

Television programs that originate on film can be transferred from a print made from the camera negative or the negative itself. Each has its own "look"; therefore both have been transferred to video in this demonstration. The "look" of each is as a program producer might want to see it. With a properly calibrated monitor, (See Chapter Five or Seven and the Program

Notes in this book.), the differences between the two sections will stand out. The choice of transferring print or negative, where both are available, is normally made for artistic considerations. One is not necessarily more correct than the other. Viewers may be able to determine if subsequent programs being examined were transferred from print or negative. The latest generations of Ranks are better able to get the desired look out of either print or negative film.

11541            First Black, part of the opening count down.

A video title has been added to this two second section of the leader. This is the point where the two audio sources and video become independent of each other. Separate Analogue and Digital Audio demonstrations start in 18 seconds while the film demonstration continues in the video.

11587            First Film Test Chart

The Eastman Kodak LC (Low Contrast) Print Film 5380 transferred to video in this section was made directly from the original camera negative after the negative was edited. There are a number of items to note in the print section that will be compared to the original negative transfer.

The opening test chart of each section provides an indication of the differences between print and negative film transfer. Pay close attention to the gray steps, both at the light and dark ends. Note the separation, or lack of separation, between the individual gray scale steps.

The chart in this section says it is a negative. It originally was a negative until it was transferred to this print. The print process does not change letters or words in the negative material.

11768            Ski Slope

Note the detail in the jeans and black gloves, as well as in the ski slope in the background. Try to relate this picture information to the displayed gray scale of the test chart.

11972            Country and Western Band

(Start of the separate analogue and digital audio demonstrations that continue through to the end of Chapter Five.)

From an artistic point of view, attention is first brought to the singer. The lighting of this scene, as it is displayed in video, makes the singer stand out when compared to the rest of the picture. There is very little detail in the dark background. The other two people in this scene have much less perceived picture intensity.

12164            Grocery Store

Observe the detail in the purse in the shopping cart and eventually the detail in the hair of the person on the left side of the screen. Note the color saturation of the fruit in the background.

12691            Kitchen

Look for detail around the cookie jar on the counter; center right portion of the picture, and color saturation in the apron.

12812            35 mm Negative Film Count Down

The Negative Film Segment is edited original camera material as follows: Test Chart and Ski Slope: Eastman Color Negative Film 5247, Country & Western Band, Grocery Store, and Kitchen: Eastman Color High Speed Negative Film 5294.

Compare findings from the print transfer with the "look" of the negative transfer. Keep in mind that the "correct" translation of these pictures is in the mind of the people making the original transfer. The "best" one can do at home is see the picture as it was presented in the transfer process.

13004            Test Chart

In each case, print and negative, a portion of the gray scale chart is "compressed". Most film has a capability of preserving a much larger contrast ratio than the television system can record or play. (There are also differences in the contrast ratio of print and negative film.) Decisions have to be made on how to compress the larger film contrast capability into the smaller capability of the television system. Adjustments to the video picture quality, as the film gets translated, can be made on a scene by scene, or frame by frame basis with this film chain.

13166            Ski Slope

There is more detail in the dark areas of the picture. The ski slope in the background seems to be a little more washed out.

13363            Country and Western Band

The focal point of this picture has changed. With all the extra detail in the dark areas of the picture, the red spot behind the singer is almost as dominate as the singer. All three people now compete for attention.

13572            Grocery Store

Detail in the purse and hair come out.

14161            Kitchen

The background is much lighter and the saturation of the apron is different.

Think about the television programs that originate on film. Many of them will clearly fit into the Negative or Print Film "look".

14277 SMPTE Resolution Pattern

Frame count returns to 30 frames per second.

14324 CX Encoding1 On (Analogue Tracks Only)

A code in the video's vertical interval will automatically turn the CX Decoder "On" in most of the newer videodisc players. In older players, the CX Decoder will have to be manually activated. The purpose of this section is to provide a demonstration of the CX Noise Reduction System1. CX is not used in the digital audio tracks nor should it be used on any disc that has completely different audio in the left and right analogue audio tracks; such as in dual language discs.

Details About Video

CHAPTER FIVE: "Audio Demonstration with Video Test Signals"

Separate audio demonstrations, both in the analogue and digital tracks continue to the end of this chapter. Automatic "Picture Stops" are not possible in this section, as they would interrupt the audio demonstrations.

The video in this chapter is designed to be interactive. Select particular material for review or just continue with the demonstration. Notes about the video test signals follow in the "Video Application Notes" and "Details About the Video Test Signals" sections of the book.

(Still Frame Sequence):

- 14377 Chapter Five Opening Frame
- 14378 Identification of Video Test Signals:
- 14379 SMPTE Color Bars
- 14382 Gray Scale
- 14384 Multiburst
- 14387 Full Field PLUGE
- 14390 PLUGE w/ Log gray scale
- 14393 PLUGE w/ 100% White
- 14396 250 KHz Square
- 14398 SMPTE Resolution Pattern
- 14400 Full Field Color Bars
- 14403 EIA Color Bars
- 14405 100 IRE Window
- 14407 70 IRE Window
- 14409 30 IRE Window
- 14411 Positive & Negative Needle Pulse
- 14413 VIR, Full Field Version of the Vertical Interval Reference signal
- 14415 Color Bars w/ Decoder Reference Level

14418	Field Rate Gray Scale
14420	Color Bars w/ Gray Scale
14422	Minimum Phase Change Color Bars
14426	Maximum Phase Change Color Bars
14430	Full Field Red
14432	Checkerboard
14434	Field Rate Color Bars
14436	Waveform Monitor Functions:
14447	Vectorscope Functions:
14453	Component Digital Recording: D1, the system used to originate this program.
14463	Video Graphics:
14673	BTS/Bosch FGS 4000 3D Video Graphics System
14727	Rendering a Single Frame of Animation

Once the animation sequence was designed, the BTS/Bosch FGS 4000 took up to a minute to generate each picture in the animation. After each frame was generated, the D1 would capture it as a single frame, one of 30 needed for each second of animation.

16345	Video Production Switcher:
16425	Video Switching
16515	Video Mixing
16605	Video Wipe Patterns
16745	Video Key: Title Over Video

#### MONITOR CALIBRATION:

	(Still Frame Sequence):
16785	Monitor Calibration (See Video Application Notes)
16786	Initial Setup
16790	Purity
16792	Convergence
16794	Geometry
16798	CIE Diagrams
16801	Black Body Curve of the CIE Diagram
16801	Zooming in on the color of Gray
	(Still Frame Sequence):
17130	Gray is 6500øK
17131	Gray Ramp
17132	Gray Scale calibration
17136	Flat Field
17142	Standards Transfer Devices
17145	Establishing the correct color of gray
17149	Setting a Gray Scale
17151	Check gray scale tracking
17164	Setting Black & White Levels

- 17166 Use of "PLUGE" to set black
- 17173 Setting White Level with a meter
- 17175 Maximum white level
- 17176 Color Control Settings
- 17177 SMPTE Pattern identification
- 17178 Correctly adjusted color bars
- 17180 SMPTE Color Bar pattern use
- 17182 Monitor Environment

IDEAL VIEWING CONDITIONS:

- 17183 Ideal Viewing Conditions
- (Still Frame Sequence):
- 20457 Monitor Environment
- 20461 Field of view
- 20464 Perception of color
- 20465 Color of lights and walls
- 20471 SMPTE address

BASIC TELEVISION:

- 20472 Basic Television
- 20473 525 lines
- 20474 Luminance
- 20475 Color added to Black & White
- 20476 Defining NTSC
- 20477 NTSC Equations
- 20478 Picture tubes:
- 20479 Delta-Delta
- 20481 In-line dot
- 20482 Slot mask
- 20483 Trinitron4
- 20484 CX1 Encoding Off (Analogue Tracks Only)

The decoder in most new videodisc players will shut off automatically from a code placed in the video's vertical interval. Some older players will require the operator to manually turn off the CX decoding process.

DISC REPLICATION:

- (Still Frame Sequence):
- 20515 Disc Replication at Disctronics
- 20516 Blue Laser used to expose the photo-resist coated on the glass mastering plate.

- 20517 Mastering Table and Support Electronics: The air-suspended table in the foreground contains the laser, optical path, the modulator, and turntable. The electronics support system is in the racks along the wall.
- 20518 Front View of the Mastering Table: The turntable, with the glass mastering plate, can be seen in the foreground. The LED meter, off to the right, indicates the power output of the laser. The setting is abnormally high so the laser light will show up in the photograph. Mastering is done in a class 100 clean room. Lighting in this room is yellow in color (lacking blue) because the photo-resist on the glass plate is exposed by blue light, the color of the laser light. Yellow room light will not expose the glass master.
- 20519 Electroforming: This is the second stage of depositing metal on the processed glass master.
- 20521 Removing the metal from the glass. This piece of metal can be used directly as a stamper or be used to generate other stampers.
- 20526 The metal piece shown is for a CD. Note that only the inside area of the metal contains information. The outside will be trimmed away and a center hole punched when this piece of metal becomes a stamper. The glass will be cleaned, processed, and re-used for mastering.
- 20527 Metallization of the information side of the plastic replica takes place here. Note the beginning of the disc assembly line on the right side of the picture. The glass window behind the disc holder looks out onto the rest of the disc assembly line.
- 20528 The chamber used in the plastic replica's metallizing process is in the background with the controls up front. The discs shown here have been metallized.
- 20529 A protective layer is added to the metal before glue is applied. This machine is adjacent to the metallizing chamber.
- 20530 The bonding machine is in the foreground with the edge trimmer in the background. The bonding machine puts the two sides of a laser disc together.
- 20531 The edge trimmer is detailed in the foreground, the bonding machine in the middle and the hot melt machine in the back. There is a hole in the back wall for the discs to pass thru from the protective coating machine.
- 20532 Vacuum Metallizer. Once the laser has exposed the glass disc and the photo-resist developed, a very thin layer of metal is vacuum deposited on the glass.
- 20535 The glass master being revealed with its first coating of metal.
- 20542 Inspection of the metallized glass master. This particular master is a CD. It is now in a condition where it can be played for the first time.
- 20543 Master Playing Room, Quality Control. Masters are checked here before sufficient metal is added to separate the metal from the glass.
- 20544 Final Product Quality Control Room. The red light in the background was placed there for this photograph, an artistic effect. It is not part of the normal QC environment.
- 20545 Injection Molding machines
- 20546 CD Injection Molding Machine
- 20547 Plastic CD's being stacked
- 20549 Protective Coating and Label Screening for CD's
- 20551 Glass preparation area for mastering

## SPEAKER LOCATION:

20554	Ideal Speaker Location: Press "PLAY"
20840	Dolby Surround Sound2: Press "PLAY"
21140	Dolby Pro-Logic Surround Sound2: "PLAY"
21500	Decoding Surround Sound
21655	Surround Speaker Location: Press "PLAY"
21857	Speaker location used in the Dolby Surround Sound mastering process for this program.
21932	Dolby Laboratories Trade Mark: Press "PLAY"
22055	Luminance Signal to Noise Test Patterns:
22260	80 IRE Flat Field
22445	50 IRE Flat Field
22635	20 IRE Flat Field
22743	Chroma Signal to Noise Test Patterns:
22794	Blue
22990	Magenta
23166	Yellow

These patterns have been provided in real time so that both still frame and real time signal to noise measurements can be made.

23310	ANALOGUE AUDIO TRACK:
23433	Walton: Facade Suite
23643	Pachelbel: Kanon
23853	Respighi: Church Windows
24063	DIGITAL AUDIO TRACK:
24183	Honeysuckle Rose
24363	Misturada

## Audio Test Signals

### CHAPTER SIX: "Audio Test Signals"

#### Caution!

1. There are ten automatic picture stops that divide the chapter into useful sections. They also prevent the user from accidentally entering high signal level areas. Do not attempt to play through this chapter without observing the Cautions placed in it. (When using the Pioneer VP-1000 Video Disc Player, have the frame display on at all times while working with Chapter Six.)

2. Pick the Audio Test section needed from the list below and proceed directly to it. (Initial audio system calibration is covered in the "Getting Started" section of this book.) The entire chapter is not normally needed to set up an audio system.

3. Set the videodisc player up for automatic repeat of a particular section needed by using the player's "looping" function. Play through the selected tones.

4. Proceed to another chapter once the desired audio tests have been completed.

(Still Frame Sequence):

24543 Opening explanation (Picture Stop)

24545 Caution!

24546 Listening Tests:

24561 Pink Noise @ -20 dB Reference Level

This series of tones is designed for Dolby Surround Sound2 Decoders that address three channels; Left, Right, and Surround speakers. The Left + Right signal should sound as if it is coming from the center, between the left and right speaker. The Left - Right, (L-R), signal should come from the surround speakers. Set up the decoder so that the level coming from all sets of speakers appears to be equal at the prime listening position. Accurate settings can be obtained by using a sound pressure level meter.

These test tones are also useful in setting up a standard two channel (stereo) audio system. In a properly adjusted stereo system the Left + Right signal will appear to be coming from the center of the room and the Left - Right signal will have a diffuse and directionless quality.

25056 Pink Noise @ -20 dB Reference Level For Dolby Surround Pro - Logic Systems

The Dolby Pro-Logic Surround Sound2 decoding system decodes to four channels: Left, Right, Center, and Surround. All Dolby Pro-Logic Decoders contain their own internal calibration signals. The disc's signals allow an external check of the decoder from a program source.

25430 1 KHz @ -20 dB Reference Level

The Surround Sound2 Decoder and Pro - Logic Surround Sound2 sequence is repeated using a 1 KHz tone. The tone sequence is useful for setting meter levels. Note: When Left and Right channels are both on, the level in each channel is 3 dB below the individual channel level.

26286 Audio Calibration Tones (Picture Stop)

26287 1 KHz @ -20 dB, 8 seconds each

26302 Left

26542 Right

26782 Left + Right @ -23 dB

27022 Left - Right @ -23 dB

27261 100 Hz @ -20 dB, 8 seconds each

27276 Left

27516 Right

27756 Left + Right @ -23 dB  
 27996 Left - Right @ -23 dB  
 28235 10 KHz @ -20 dB, 8 seconds each  
 28250 Left  
 28490 Right  
 28730 Left + Right @ -23 dB  
 28970 Left - Right @ -23 dB  
  
 29209 Log Sweep Signals: (Picture Stop)  
  
 29210 100 to 15 HZ @ -20 dB, 8 seconds each  
 29225 Left  
 29465 Right  
 29705 Left + Right @ -23 dB  
 29945 Left - Right @ -23 dB  
 30184 100 to 10 KHz @ -20 dB, 8 seconds each  
 30199 Left  
 30439 Right  
 30679 Left + Right @ -23 dB  
 30919 Left - Right @ -23 dB  
 31158 10 K to 21 KHz @ -20 dB, 4 seconds each  
 31173 Left  
 31293 Right  
 31413 Left + Right @ -23 dB  
 31533 Left - Right @ -23 dB  
 31653 15 to 21 KHz @ -20 dB, 8 sec. Full Range Sweep  
 31668 Left  
 31908 Right  
 32148 Left + Right @ -23 dB  
 32388 Left - Right @ -23 dB  
  
 32627 Narrow Band Noise Sweep Signals:  
  
 32628 100 to 15 Hz @ -20 dB, 8 seconds each  
 32642 Left  
 32882 Right  
 33122 Left + Right @ -23 dB  
 33362 Left - Right @ -23 dB  
 33601 100 to 10 KHz @ -20 dB, 8 seconds each  
 33616 Left  
 33856 Right  
 34096 Left + Right @ -23 dB  
 34336 Left - Right @ -23 dB  
 34575 10 K to 20 KHz @ -20 dB, 4 seconds each  
 34590 Left  
 34710 Right

34950 Left + Right @ -23 dB  
 35040 Left - Right @ -23 dB  
 35191 15 to 20 KHz @ -20 dB, 8 seconds each  
 35205 Left  
 35445 Right  
 35685 Left + Right @ -23 dB  
 35925 Left - Right @ -23 dB  
  
 36164 Audio Test Tones Requiring Instrumentation (Picture Stop)  
 36165 ... CAUTION! ...  
  
 36166 1 KHz @ -20 dB Reference Level, 8 seconds each  
 36181 Left  
 36421 Right  
 36661 Left + Right @ -23 dB  
 36901 Left - Right @ -23 dB  
 37140 1 KHz @ -40 dB, 8 seconds each  
 37155 Left  
 37395 Right  
 37635 Left + Right @ -43 dB  
 37875 Left - Right @ -43 dB  
 38114 1 KHz @ -60 dB, 8 seconds each  
 38129 Left  
 38369 Right  
 38609 Left + Right @ -63 dB  
 38849 Left - Right @ -63 dB  
 39088 1 KHz @ -80 dB, 8 seconds each  
 39103 Left  
 39343 Right  
 39583 Left + Right @ -83 dB  
 39823 Left - Right @ -83 dB  
 40062 1 KHz @ -90 dB, 8 seconds each  
 40077 Left  
 40317 Right  
 40557 Left + Right @ -93 dB  
 40797 Left - Right @ -93 dB  
 41036 1 KHz @ -20 dB Reference Level, 8 seconds each  
 41051 Left  
 41291 Right  
 41531 Left + Right @ -23 dB  
 41771 Left - Right @ -23 dB  
  
 42010 Caution! (Picture Stop)

\* The Left and Right signals noted in the following sections reach the very peak of the digital system's capability of accurately storing an audio signal. The digital signal in this section is

accurate and legitimate within the specifications of the system. Some digital to analogue converters may not reconstruct this signal properly. All digital to analogue converters should be able to accurately reproduce the Left + Right and Left - Right signals following the individual Left and Right signals.

42011	1 KHz @ -10 dB, 8 seconds each
42026	Left
42266	Right
42506	Left + Right @ -13 dB
42746	Left - Right @ -13 dB
42985	1 KHz @ 0 dB, 8 seconds each
43000	*Left
43240	*Right
43480	Left + Right @ - 3 dB
43720	Left - Right @ - 3 dB
43959	Caution! (Picture Stop)
43960	1 KHz Square Wave, Wideband (Picture Stop)
43961	1 KHz Square Wave @ -20 dB, 8 seconds each
43967	Left
44216	Right
44546	Left + Right @ -23 dB
44696	Left - Right @ -23 dB
44935	1 KHz Square Wave @ 0 dB, 8 seconds each
44950	*Left
45190	*Right
45430	Left + Right @ - 3 dB
45670	Left - Right @ - 3 dB
45909	1 KHz Square Wave, 20 KHz Limited
45910	1 KHz Square Wave @ -20 dB, 8 seconds each
45924	Left
46164	Right
46404	Left + Right @ -23 dB
46644	Left - Right @ -23 dB
46883	1 KHz Square Wave @ 0 dB, 8 seconds each
46899	*Left
47139	*Right
47379	Left + Right @ - 3 dB
47619	Left - Right @ - 3 dB
47849	IEC Two Tone Sweep (Picture Stop)

This is an intermodulation test. There are two tones, 70 Hz apart, that are swept from 300 Hz to 20 KHz. Distortion can be measured by using a 70 Hz band pass filter on the output of the audio device being tested.

- 47850            Caution! (Picture Stop)
  
- 47851            IEC Two Tone @ -20 dB, 8 seconds each
- 47865            Left
- 48105            Right
- 48345            Left + Right @ -23 dB
- 48585            Left - Right @ -23 dB
- 48823            IEC Two Tone @ 0 dB, 8 seconds each
- 48837            \*Left
- 49077            \*Right
- 49317            Left + Right @ -3 dB
- 49557            Left - Right @ -3 dB

\* The Left and Right signals noted in the proceeding sections reach the very peak of the digital system's capability of accurately storing an audio signal. The digital signal is accurate within the specifications of the system. Some digital to analogue converters may not reconstruct this signal properly. All digital to analogue converters should be able to accurately reproduce the Left + Right and Left - Right signals following the individual Left and Right signals.

- 49795            DAC Monotonicity Test (Picture Stop)

The DAC Monotonicity test is designed to exercise all the bits in the digital audio system. It is a .5 Hz triangle wave at full amplitude with a 1 KHz Sine wave at -60 dB. If distortion is present in the digital to analogue conversion process it can be heard, or measured, by placing a 100 Hz high pass filter and a 1 KHz notch filter at the analogue audio output of the digital converters.

Filtering present in analogue audio circuits will probably make this test useless as it is found on the analogue audio tracks of the disc.

Caution!

There will be pops at the beginning and between the four test sections. They come from the sudden shift in DC level as we enter and exit the .5 Hz triangle wave at different levels.

- 49811            Left
- 50051            Right
- 50291            Left + Right
- 50531            Left - Right
  
- 50769            End of Audio Test Signals

Monitor Calibration Test Signals

CHAPTER SEVEN: "Monitor Calibration Test Signals"

Chapter 7 is located near the outside edge of the disc, where video parameters are at their best in a CAV disc. Video test signals have been organized in a sequence needed for monitor calibration followed by patterns used for additional monitor or video system evaluation. The test signal description and application frames found in Chapter 5 have been removed in this sequence. Some of the test patterns are designed to be used with external test equipment in addition to being observed on a display device. A separate alphabetical index to all of the test patterns found in the disc is provided in the "Video Test Signals" section of this book.

The video output level of one disc player may be slightly different from another. The SMPTE Color Bar pattern, 100 IRE Window, Gray Ramp, Needle pulse, 100 IRE Flat Field, etc. all have 100 IRE references in them. The levels listed below for test patterns have been measured after the player output was properly calibrated.

- (Still Frame Sequence):
- 50780 Chapter Seven Opening Frame (Picture Stop)
- 50781 Field Rate Gray Scale (Horizontal Stripes)
- 50782 Line Rate Gray Scale (Vertical Stripes)
- 50783 High Level Window Pattern
- 50784 Low Level Window Pattern
- 50785 PLUGE with Logarithmic Gray Scale
- 50786 High Level Window Pattern
- 50787 Needle Pulse
- 50788 SMPTE Color Bars \* w/ labels.
- 50789 SMPTE Resolution Chart
- 50790 Multiburst
- 50791 Chroma to Luminance Delay Check Pattern 1
- 50792 Decoder Pattern (R-Y, B-Y)
- 50793 Chroma to Luminance Delay Check Pattern 2
- 50794 Combination Pattern
- 50795 80 IRE Flat Field
- 50796 50 IRE Flat Field
- 50797 25 IRE Flat Field
- 50798 Blue
- 50799 Magenta
- 50800 Yellow
- 50801 100 IRE Window Pattern
- 50802 95 IRE Window Pattern
- 50803 90 IRE Window Pattern

50804	87 IRE Window Pattern
50805	82 IRE Window Pattern
50806	75 IRE Window Pattern
50807	65 IRE Window Pattern
50808	55 IRE Window Pattern
50809	47 IRE Window Pattern
50810	38 IRE Window Pattern
50811	29 IRE Window Pattern
50812	21 IRE Window Pattern
50813	18 IRE Window Pattern
50814	14 IRE Window Pattern
50815	SMPTE Color Bars *
50816	Multiburst
50817	PLUGE with Logarithmic Gray Scale
50818	Modulated Ramp
50819	Full Field Red
50820	Crosshatch (Convergence) Pattern
50821	Full Field Color Bars
50822	EIA (Split Field) Color Bars *
50823	100 IRE Flat Field
50824	50 IRE Flat Field
50825	10 IRE Flat Field
50826	Color Bars w/ Frequency Bursts and Gray Ramp
50827	Chroma Wedge
50828	Indian Head Resolution Pattern (7 Frames)
50835	End of Test Patterns

\* The I & Q signal amplitudes in the SMPTE and EIA Color Bars are not correct. The phase should be correct. All the test signals in the D1 master originated in the R G B domain. I & Q do not exist in that domain. R - Y and B - Y, the signals used to derive I & Q, have been provided for decoder alignment in other test patterns.

## Who's Who in the Program

### CHAPTER EIGHT: "Who's Who"

	(Still Frame Sequence):
50836	Chapter Eight Opening Frame (Picture Stop)
50837	Joe Kane
50839	Reference Recordings
50840	Tam Henderson
50841	Keith Johnson
50842	Marcia Martin
50843	AME, Inc.
50844	Robert Bajorek

50845 Jan Yarbrough  
 50846 Crystal Sound  
 50847 Kevin Braheny  
 50848 Kevin Braheny & Keith Johnson  
 50849 Discronics  
 50850 Alan Hamersley  
 50851 Dolby Laboratories, Inc.  
 50852 David Gray  
 50853 Doug Greenfield  
 50854 Modern Video Film  
 50855 Modern Sound at Modern Video Film  
 50856 Chris Haire  
 50857 Doug Davey  
 50858 Richard Greenberg  
 50859 Guy Tsujimoto  
 50860 Bill Wistrom  
 50861 KAS REALITIES  
 50862 Kurt Shanaman  
 50863 Tom Thornton  
 50864 TAV Trans-American Video  
 50865 Mark Dennison  
 50867 Joel Groch  
 50869 Individual Assistance  
 50870 Mark Humphrey  
 50871 Eldon Phillips  
 50872 Terry Pickford  
 50873 Russ McMurtray  
 50874 Ron Williams  
 50875 Film Transfer  
 50876 Audio Test Signals Mark Davis  
 50877 Support from Equipment Manufacturers  
 50878 Support Documentation from:  
 50879 Special Thanks To:  
 50880 Conrac "Raster Graphics" Book  
  
 50881 Program Closing  
  
 51689 Reference Recordings Program Exit  
  
 52243 Last Frame of the Program

## Program Elements

### Audio, Alphabetical Location

Most of the audio test signals in Chapter Six are sequenced for left only, right only, left plus right, and left minus right. The test signal name, a brief description, and the sequence starting point are listed here.

-20 dB = Reference Level = 0 VU = +85 dB spl

#### Frequency Sweep Signals:

##### IEC Two Tone

300 Hz to 20 KHz @ 0 dB 48823  
300 Hz to 20 KHz @ -20 dB 47851

##### Log Sweep

100 Hz to 15 Hz @ -20 dB 29210  
100 Hz to 10 KHz @ -20 dB 30184  
10 KHz to 21 KHz @ -20 dB 31158  
15 Hz to 21 KHz @ -20 dB 31653

##### Narrow Band Noise

100 Hz to 15 Hz @ -20 dB 32628  
100 Hz to 10 KHz @ -20 dB 33601  
10 KHz to 20 KHz @ -20 dB 34575  
15 Hz to 20 KHz @ -20 dB 35191

#### Level Sweep Signal:

DAC Monotonicity Test 49811

Pink Noise @ -20 dB 24561, 25056

#### Tones:

##### Sine Wave

100 Hz @ -20 dB 27261  
1.0 KHz @ 0 dB 42985  
1.0 KHz @ -10 dB 42011  
1.0 KHz @ -20 dB 25430, 26287, 36166, 41036  
1.0 KHz @ -40 dB 37140  
1.0 KHz @ -60 dB 38114  
1.0 KHz @ -80 dB 39088  
1.0 KHz @ -90 dB 40062  
10.0 KHz @ -20 dB 28235

##### Square Wave; Limited Bandwidth

1.0 KHz @ 0 dB 46883  
1.0 KHz @ -20 dB 45910

Square Wave; Wideband  
1.0 KHz @ 0 dB 44935  
1.0 KHz @ -20 dB 43961

Exercise Caution! with audio levels above the -20 dB Reference Level.

## List of Drawings & Diagrams

There are a number of important drawings, diagrams, and text frames in this program. An alphabetical listing is provided here. Other lists that will help find elements in the program are found in "Program Chapter & Frame Index w/Notes", "Audio", and "Details About Video Test Signals".

List of Still Frame Pictures:

BETACAM Camera Specifications 5076 - 5080

BTS FGS 4000 3D Graphics 14700

Black Level Calibration 17164 - 17172

Camera Registration 3540

Chip Chart 3790

CIE Diagram:

Color detail 16801 - 17130

Full 16798

Outline 16799, 16800

Color Analyzers 17142

Color Control Calibration 17177 - 17179

CRT Drawings

Basic CRT 16690

Delta-Delta 20479, 20480

In Line Dot 20481

Slot Mask 20482

Trinitron4 20483

D1 Digital System

Audio parameters 14460

Record system 14453 - 14456

Video parameters 14459

D6500 Lighting 19755, 20467 - 20470

D6500 Reference Light 17146

Disc Replication 20515 - 20553

Environment, Viewing 17183 - 20456, 20457 - 20470  
 Film Chain Operation 11388 - 11396

Gamma Curves 16693

NTSC  
 Definition 20476  
 Equations 20477

Optical Comparator 17146

Perception of Light 20459 - 20463

Scanning a CRT 20473

SMPTE Address 20471

Speaker Location 20554 - 21930

Telecine Chain 11388 - 11396

Two/Three Pulldown 11396

Vectorscope 14402, 14424, 14428, 14447 - 14452  
 Video  
 525 Line Formats 14457, 14458  
 Luminance 20474  
 Y + Color 20475

Viewing Environment 17183 - 20455

VTR Formats 14461

Waveform Monitor 14381, 14389, 14392, 14395, 14417, 14436 - 14446, 20474, 20475

Video Test Signals

Alphabetical Location

The video level output of one disc player may be slightly different from another. Knowing that some of the patterns; SMPTE Color Bars, 100 IRE Window, Gray Ramp, Needle pulse, 100 IRE Flat Field, etc. have 100 IRE references in them, the disc player used to check these patterns was calibrated for that level before subsequent levels were measured.

TEST PATTERN: LOCATION IN THE DISC BY FRAME NUMBER:

BLACK: 5073, 5082 - 5086, 11232, 11310 - 11314, 50770 - 50779, 50882 - 50920

BLUE ONLY DISPLAY: 17179

CHROMA PATTERNS:

Auto tint 50791, 50794  
Blue 22795 - 22920, 50798  
Combination 5070, 50794, 50826  
Delay 50791, 50793, 50794  
Magenta 22990 - 23100, 50799  
R - Y, B - Y 50792, 50794  
Red 5063, 14430, 16790, 50819  
Wedge 5071, 50827  
Yellow 23165 - 23280, 50800  
Yellow/Red 50791

COLOR BARS:

Blue Only Display 17179  
Combination 5070, 50826  
EIA \* 5066, 14403, 50822  
Field Rate 14434  
Full Field 3797 - 3806, 3821 - 3832, 3846 - 3858, 3871 - 3882, 3896 - 3907, 3920 - 3924,  
5065, 14400, 50821  
Gray Reference 14415  
Gray Scale 14420  
Maximum Phase Ch. 14426  
Minimum Phase Ch. 14422  
Mixed Field 3820, 3883, 3895, 3919  
SMPTE \* 3807 - 3819, 3833 - 3845, 3859 - 3870, 3884 - 3894, 3908 - 3918, 5059, 17165,  
14379, 50815  
SMPTE w/labels \* 17177, 50788

COMBINATION: 5070, 50794, 50826

CONVERGENCE: 5064, 16793, 50820

CROSSHATCH: 5064, 16793, 50820

FILM CHARTS:

Negative 13004 - 13114  
Print 11587 - 11766

FLAT FIELD:

100 IRE 5067, 50823  
80 IRE 50795  
60 IRE 17138  
50 IRE 5068, 50796, 50824  
25 IRE 17137, 50797  
12 IRE 5069, 50825

FULL FIELD RED: 5063, 14430, 16790, 50819

GEOMETRY:

Checkerboard 14432, 16794  
Crosshatch 16792, 50820  
Indian Head 50828 - 50835

GRAY SCALE:

Combination 5070, 50794, 50826  
Field Rate 14418, 50781  
Line Rate 14382, 50782  
Modulated 5062, 50818  
Ramp 17131

MULTIBURST: 5060, 14384, 50790, 50816

NEEDLE PULSE: 14411, 17175, 50787

PLUGE:

alone 14387  
w/Color Bars \* 3807 - 3819, 3833 - 3845, 3859 - 3870, 3884 - 3894, 3908 - 3918, 5059,  
14379, 17165, 17177, 50788, 50815  
w/Gray Scale 5061, 14390, 17169, 50785, 50817  
w/100 IRE White 14393, 17168

RED FIELD 5063, 14430, 16790, 50819

RESOLUTION:

Indian Head 50828 - 50835  
Multiburst 5060, 14384, 50790, 50816  
SMPTE 14277 - 14325, 14398, 50789

SIGNAL/NOISE:

80 IRE 22205 - 22384  
50 IRE 22385 - 22564

20 IRE        22565 - 22742  
Blue 22794 - 22989  
Magenta      22990 - 23165  
Red 5063, 14430, 16790, 50819  
Yellow        23166 - 23309

SQUARE WAVE:    14396

VIR:    14413

#### WINDOW PATTERN:

100 IRE        14405, 17144, 17152, 17174, 50783, 50786, 50801  
95 IRE        17153, 50802  
90 IRE        17154, 50803  
87 IRE        17155, 50804  
82 IRE        17156, 50805  
75 IRE        17157, 50806  
70 IRE        14407  
65 IRE        17158, 50807  
55 IRE        17159, 50808  
47 IRE        17160, 50809  
38 IRE        17161, 50810  
30 IRE        14409  
29 IRE        17162, 50811  
21 IRE        17163, 50812  
18 IRE        50784, 50813  
14 IRE        50814

\* The I & Q signal amplitudes in the SMPTE and EIA Color Bars are not correct. The phase should be correct. All the test signals in the D1 master originated in the R G B domain. I & Q do not exist in that domain. R - Y and B - Y, the signals used to derive I & Q, have been provided for decoder alignment in other test patterns.

If it is necessary to obtain a video test signal quality as close to the original as possible, a video processing amplifier at the output of the videodisc player will be necessary. Pictures of the video waveforms, as the signals came directly out of the RGB to NTSC encoder, are provided in the Test Signal Identification section of Chapter Five. The video processing amplifier should be adjusted to obtain as close to the same results, from the disc signal, as is presented in the pictures of the waveform monitor and vectorscope.

## Audio Test Signal Use

There are audio test tones in Chapter Six that can damage audio amplifiers, speakers, and one's hearing if caution is not taken with level controls. Do not attempt to play through this chapter without observing the Cautions placed in it. There are ten automatic picture stops that prevent the user from accidentally entering high signal level areas.

When using the Pioneer VP-1000 Video Disc Player, have the frame display on at all times while working with Chapter Six. Press the "Play" button twice when starting the disc before turning on the frame display. This is necessary to activate the automatic picture stop function of the player.

While all of the test signals will address surround sound decoders, the center and surround speakers in the video do not flash in most of the test sequences. They do not flash to avoid confusion with standard testing procedures.

"L-R" is used in the video text when the right channel audio is 180° out of phase with the left channel. A Dolby Surround Sound2 decoder will place this information in the rear channel.

The word "PLAY" appears on a single frame at the beginning of most test signals. It can be used as a trigger point for external measuring equipment.

Some digital decoders do not produce an output at the exact instant the disc goes into play. There may be as much as a 5 to 15 frame delay before audio actually starts. It may be necessary to back up several frames, from the "PLAY" point in order to have audio output at the "PLAY" frame.

The "dB" numbers used in this sequence are relative to the peak recording level of the digital audio system. A standard reference tone in the digital domain is 20 dB below the peak, (-20). The lowest test signal level presented in this program is 93 dB below the peak recording level.

This recording was monitored during the digital transfer and analogue mix with a sound pressure level (spl) of +85 dB at the primary listening position at reference level; -20 dB in the digital audio dB numbering system.

Levels coming from both the left and right channel, when both are producing sound at the same time, are 3 dB below the level of individual channels. This is done to maintain the same spl with both speakers as when just the left or right speaker is producing sound. The 3 dB change, which is not noted in the video text, will be seen on a dB metering system.

The opening pink noise and 1 KHz tones in Chapter Six were sourced from an analogue audio generator. They were fed through the mixer (pictured in Chapter Eight) and converted to a digital signal. These signals have been provided for level adjustment only. They do not sound exactly the same coming from each channel. The left and right signal paths in the audio mixer had a slightly different response to the single tone source. The levels from both channels are equal.

## Audio Notes

### 1. Reference Level

The dB numbers shown on the screen, and in the text, correspond to the dynamic range of the digital audio recording system. See Figure 5. The peak recording capability is 0 dB. The lowest

level in the digital system is in the order of 90 dB below the peak (-90 dB). In normal recording, 0 VU, or 1 milliwatt of power into a 600 ohm load, is a "reference level". The digital recording system is spaced about 0 VU so that 20 dB is available above reference and 70 dB or more is available below reference. In other words 0 VU = -20 dB in the digital system. 0 VU also equals +85 dB sound-pressure level in a properly calibrated audio monitoring system.

## 2. Analogue and Digital Audio Tracks

Mastering the audio for this program presented a number of interesting challenges. The source audio for the analogue and digital tracks were essentially the same wide dynamic range signals. The disc's two audio systems differ greatly in their ability to record both amplitude and frequency response. Several compromises had to be made in translating the source audio into the analogue tracks.

In Figure 4, notice that the analogue audio carriers are located just below the video carriers. Their peak amplitude is 26 dB below the video carrier to reduce interference between the audio and video signals. Audio signals at reference level or above, containing high frequency information; above 10 KHz, exceed the disc system's capability. This material will get translated as noise. The problem is worse in the right channel because it is closer to the video carrier.

Dynamic range limitations of the analogue channels prevented recording levels more than 10 dB above reference. Signal levels, that on the screen, (and in the text), indicate they are 20 dB above reference level actually are only about 11 dB above reference in the analogue tracks. Their amplitude is being limited by the disc's mastering system.

When ever possible, use the digital audio test signals.

## 3. Dolby Surround Sound2 Decoder Notes

Graphics in Chapter 5 indicates that consumer Dolby Surround Sound decoders are three channel devices (left, right, and surround) and Dolby Pro-Logic Surround Sound decoders are four channel devices (left, right, center, and surround).

The audio bandwidth of the surround channel of a properly designed Dolby Pro-Logic or Surround Sound decoder is not as full as the front channels. This will be noticed when the L-R frequency sweep signals are being used to test the decoder.

The surround channel information is a single channel fed to both left and right rear speakers. Most decoders provide a volume balance control between the left rear and right rear speakers.

## 4. Dynamic Range & Signal-to-Noise Ratio

As noted in the "Video Application Notes" specifications can be misleading if you don't know all of the details. Analogue audio specifications have long been both miss-used and misunderstood. Now, with the advent of digital audio, specifications for certain parameters, such as signal-to-

noise ratio (SNR), are quite different in the analogue and digital domains. Details become even more important.

In the digital domain, dynamic range; the distance between the highest and lowest volume levels that can be recorded, and SNR; how far the noise floor is below the peak volume recording level, are essentially the same numbers. Both parameters are determined by the number of digital bits (digital byte or word length) in each sample of the original analog signal.

The byte or word size of each sample in the CD format is 16 bits. The sampling rate of 44.1 KHz determines the analog frequency response of the digital channel. The 16 bit word length allows for about a 90 dB dynamic range and a 90 dB SNR.

Dynamic range and SNR are not necessarily equal in the analog domain, where dynamic range can be much larger than SNR. The obvious question is, what is noise, if it isn't the bottom of the record capability of an analog system?

Figure 5 illustrates the differences. A brief and hopefully simplified explanation is in order.

One person's music is another person's noise. If this seems a little too brief and simple, take a look at how close it actually comes to reality.

In the digital world there is very little noise contributed to the recording process, as noise is known in the analogue domain. The "noise" most often heard in digital recordings is subtle changes to the sound quality. This "noise" is most often a factor of not being able to transfer all of the required analogue information to the digital domain. (The sampling rate might be too low or the size of the digital word, generated for each sample, might be too small.) It occurs throughout the dynamic range of the signal, is often random or input signal dependent, and is not easy to measure. Some people can easily hear it, others can not.

In the analogue domain, the majority of the noise is found, and easily measured, at the "noise floor" of a particular recording device. What is often miss-understood about the noise floor is that; one, it can have depth; as much as 15 to 20 dB, and two, this noise isn't necessarily uniform across the audible frequency spectrum. A human can either ignore it or at least hear into it. As an example, the noise floor of Keith Johnson's analogue three track recorder is designed to sound like room noise. As a result, usable program material can be recorded as much as 20 dB below the measured noise floor. While this analogue recorder has an SNR in the same order as a CD, its dynamic range exceeds that of a CD by 15 to 20 dB.

Pin pointing the specifications of a Reference Recordings analogue LP is equally difficult. The maximum recordable signal level is determined by the lathe used in mastering. If the volume level doesn't drive the cutter out of the groove or through the bottom of the master, the upper limit can be very good. In the mastering process, there is no exact level used as a reference level. If the music contains a large amount of dynamic range, the peak level for the entire side of the disc is set just below the peak of the cutter/mastering material combination capability.

The noise floor of an LP is affected by a number of parameters. Pops and clicks, defects in the replicated plastic, etc. establish the upper part of the noise floor. (The turntable and environment of the turntable contribute to the noise floor at some level.) Pressing LP records is much the same as pressing laser discs. (The first laser discs were replicated on record pressing machines. It's a small part of why MCA first got into the laser disc business in the early 1970's. They had significant influence with large record pressing plants.) The noise floor of the plastic itself is determined by particle sizes in the plastic. They should be at least an order of magnitude smaller than the size of the pits in the videodisc, something that a needle shouldn't be able to "read".

Another factor involved in the human perception of noise is the fact that most peoples' hearing is far from flat across the entire frequency spectrum. In fact, the "A" weighted noise measuring curve has a range difference of over 50 dB between 20 Hz and 1 KHz, and a range of 25 dB from 7 KHz to 20 KHz. (The range between 1 KHz and 7 KHz is only 5 dB.) The "A" weighted noise measuring curve is designed to approximate noise, as it is offensive to the human ear.

The lack of a deep noise floor in the digital audio domain can make it sound cleaner than an analogue tape recording. In reality, the analogue recording, via Keith Johnson's analogue three track, can convey much more sound information than the CD format.

The analogue audio tracks on the laser disc are noise limited by the FM system of the recorded audio. (This, providing the audio input signal is not a factor.) The FM carriers, the right channel in particular, are very close to the video carrier. High amplitudes and/or high frequencies in either the video or audio, especially occurring at the same time, can cause the side bands of the audio and video FM signals to interfere with each other. Better filtering of each of the modulated signals, before they are added together in the mastering process, can reduce some of the interaction between the audio and video information. (This overlapping of information was one of the initial reasons the CX noise reduction system was introduced to the disc.) In reality, the specifications for the carrier frequencies, which were set in the late 1960's, are too close together. As has happened with S-VHS and ED-BETA, the video carrier on the laser disc needs to be moved up, away from the analogue audio carriers. That change may not happen in an NTSC laser disc product.

Another alternative is to remove the analogue audio channels altogether. The bandwidth of the video modulator could be improved. That should result in a better video frequency response, without an increase in video noise or interference with the digital audio.

## Notes on Test Patterns

### Chroma to Luminance Delay

The function of chrominance to luminance (Y) delay patterns is to show any differences in transmission time of black & white and color information. (This is not to be confused with CRT convergence error.)

In the yellow and red pattern, the Y value of yellow is high and the Y value of red is low. If there are delay problems, the red will shift into the yellow. (There is a distinct boarder created

by the luminance differences in the two colors. The red color will spill over that luminance boarder into the yellow if there are delay problems.) The pattern with two red stripes on a white background serves the same function. It, however, has the disadvantage of a rather high average Y level that might overload the high voltage power supply.

Both patterns are designed to provide a visual indication, when displayed on a monitor, of delay inconsistencies.

Two possible sources of chrominance to luminance delay problems are video transmission lines and the color decoder. Video cables can delay the color information more than the Y information. Once the video signal reaches the video decoder, it takes time to process color information into RGB. The Y signal is delayed while the decoder derives the R - Y, and B - Y signals. If timing is wrong with either the Y delay line or the color decoder, color will appear to smear over the edges of the luminance boarders.

### Color Bar Patterns

There are a number of color bar patterns in this disc. Elements of the patterns are used, along with instrumentation, for video system alignment because they contain so much important information about the black & white and color portions of video. One pattern in particular, SMPTE Color Bars, is also useful for visually calibrating the color and black levels on a monitor. Its dual function makes it the most popular test pattern for video system checks.

The color bar patterns in this disc are "75%" bars; saturation of color is 75%. This is done to keep the amplitude of the color subcarrier at a level that can be transmitted.

In the NTSC domain, the amplitude of the reference gray bar is about 77 IRE, not 75 IRE. The translation is as follows:

$$[ | \text{NTSC Y} | 75\% ] + |\text{Setup}| = \text{Reference}$$

$$[(100 \text{ IRE} - 7.5 \text{ IRE})(75\%)] + 7.5 \text{ IRE} = 76.875 \text{ IRE}$$

If the value of Y is calculated for each of the colors, ( $Y = 0.30 R + 0.59 G + 0.11 B$ ), in the order that they appear in the color bar pattern, a gray scale will be revealed. Turn the color level on the display device down to zero, and the gray scale will appear on the screen.

EIA and SMPTE Color bars contain other elements as well. The three patches along the bottom left corner of the picture contain the NTSC encoded references; I, 100% Y, and Q. I and Q are the phase shifted, reduced bandwidth, results of R-Y, and B-Y that get modulated on the 3.58 MHz color subcarrier.

I & Q do not exist in the RGB domain. Since all the test signals in this program were generated in the RGB domain, the levels of I & Q are not correct for NTSC.

### Convergence

Crosshatch or the Convergence Pattern is intended as a reference for insuring that red, green, and blue picture information all come together properly over the entire surface of the screen. This pattern is also helpful in making picture geometry adjustments, detecting high voltage overload, and making focus adjustments.

Adjustments: When the proper adjustments are available, picture geometry should be set in the green channel before convergence is attempted. Once geometry is correct, red and blue are converged to green.

Small convergence errors near the outside edges of the CRT can be expected from consumer products. Some sets, such as the ones using the Delta-Delta tube have lots of adjustments for convergence. Most consumer sets have convergence and geometry pre-set in the tube yoke combination. There are few, if any, adjustments. Consult the service manual or a service person if objectionable errors are present. The only fix may be replacing the CRT/yoke combination.

The crosshatch on this disc has edge markers on all four sides of the pattern, in the middle of each side. These markers are very helpful where horizontal and vertical centering controls are present and being adjusted. Many consumer monitors will be overscanned enough, (the TV raster runs out beyond the edge of the screen), so that the markers won't be visible.

In a projection television system, the crosshatch is used for focus as well as convergence. In this case it is very important that the white level setting on the projector be low enough to keep the high voltage well within its regulation range. A projector's internal crosshatch is usually much lower in amplitude than the pattern on the disc.

## Geometry

There are several patterns in the program that are good for checking geometry errors. The checkerboard pattern will provide a good first approximation of geometry. The black and white boxes in the pattern are square and all the same size. Crosshatch provides the same function, but with much smaller squares. Circle patterns are available in both the SMPTE Resolution chart and the Indian Head Test pattern.

Geometry adjustments are usually available on three tube projection systems. They are often not available on consumer TV sets. The parameters of geometry and convergence are pre-set in the tube yoke combination on these consumer sets. If geometry controls are present they will have names like linearity, bow, tilt, and pincushion.

## Gray Scale

There are three basic types of gray scales in this program. One is linear, meaning that its steps in the electronic video signal are equal in height. A second is logarithmic, meaning the steps should look linear when displayed on the screen. The third is a linear ramp.

The linear gray scales, steps or ramp, are primarily used to check the linearity of a video signal path. Improperly adjusted clipping or clamping circuits can cause video circuits to be non-linear.

A gray scale is not the best choice of patterns for setting a gray scale on a monitor. Look at the gray scale differences between Frames 50781 and 50782. Any apparent shift in color between them is most likely the lack of white field uniformity in the display device. If a color analyzer is available, the gray scale should be set at the center of the screen using the high and low level Window patterns.

### Modulated Gray Scale

A Modulated Gray Scale is a Gray Scale with a fixed amount and type of color added to it. It is used to check video levels, system differential gain, and differential phase.

Differential gain measurement is a test of linearity of the gain of a video circuit from black to white. It is possible that the gain might be higher at one end of the brightness scale than another. (There are, in fact, circuits that do exactly that. They are used to compress or expand contrast range.)

Differential phase measurement is a tests of a circuit's ability to pass low luminance level to high luminance level signals that contain a color signal, without changing the color information. The color that has been added to the gray scale should be the same color at any level on the gray scale if a circuit is said to have good differential phase characteristics.

### Multiburst

The principal use of this test pattern is checking video channel frequency response. The pattern used in this program is a reduced amplitude Multiburst.

There is a gray bar on the left hand side of the pattern that serves as a signal amplitude reference. That is followed by six short burst of frequency information. In order, from left to right, they are 0.5 MHz, 1.0 MHz, 2.0 MHz, 3.0 MHz, 3.58 MHz, and 4.18 MHz. The last two bursts have special applications. The frequency of the color sub-carrier is about 3.58 MHz in the NTSC system and 4.18 MHz is the upper limit of a transmitted video signal.

Multiburst, with an additional chroma step pattern added on at the end of the line, exists throughout the program on line 20 of field 2 in the vertical interval of the video. The chroma step pattern is referred to as the "Pink Panther".

In addition to providing information on video frequency response, Multiburst can help determine the type of NTSC to RGB decoder present in a video display device and can assist in properly setting the sharpness control.

### Needle Pulse

The original intent of this pattern was to test rise and fall transition times in a video channel. The pulse is a little wider than the standard 2.5 T pulse, (where T is the maximum rise time of the video system.)

In the process of evolving standards for display monitors, it was found that this test pattern is very good at demonstrating the problems of high contrast levels.

High contrast levels often result in loss of picture resolution, gray scale distortion, and geometry errors.

As the contrast control is turned up, from its lowest position, watch the black line in the white area get smaller. Picture resolution is decreasing. Continuing to increase the contrast control may demonstrate the geometric distortions that are encountered if the CRT's high voltage goes into overload; the line will bend.

## PLUGE

This test pattern assists in properly setting picture black level. It is a part of several test patterns in this program. The phrase PLUGE (Picture Line Up Generation Equipment) and origination of the signal are credited to the BBC.

A description on how to use the PLUGE signal can be found in the Video Application Notes under Black & White Levels.

## Resolution

There are three patterns that can be used to determine video picture resolution; the SMPTE Resolution Chart, Multiburst, and the Indian Head Test Chart. The SMPTE pattern is the most accurate of the three. The SMPTE pattern and the Indian Head Test Chart provide additional information about picture geometry and scanning.

## Square Wave

250 KHz Square Wave: This is a low frequency tilt test. A square wave contains a fundamental frequency and many harmonics, (much higher frequencies). If there is frequency dependent delay in a video channel, (some frequencies taking longer to get to the end point than others), the square wave will no longer be square.

The information contained in this disc is a compilation of information from many sources. Much of the video information has evolved out of research done for committee activity of the SMPTE T14.28 Working Group on Professional/Studio Picture Monitors. Documentation came from original NTSC activity, prior SMPTE activity, individual practice and research documentation from end users, and research activity of broadcast equipment manufacturers.

## Program Running Time Calculations:

Calculations of real time, from video, are as follows: A CAV disc completely coded for video frames can contain 54,000 frames on each side of the disc. In NTSC color video there are 29.97 pictures/second.

Calculate the actual running time of 54,000 frames.

$$(29.97 \text{ pic/sec.})(X \text{ sec.}) = 54,000 \text{ pictures}$$
$$X = 54,000/29.97 = 1801.8 \text{ sec.} = 30 \text{ min.}, 1.8 \text{ sec.}$$

In AVS not all frame numbers are equal. The complete program contains 52,243 frames. 2,880 of them are coded for film, the remaining are coded for video. Calculating actual running time for the program is accomplished as follows.

Video:

$$(29.97 \text{ pic/sec.})(X \text{ sec.}) = 49,363 \text{ pictures}$$
$$X = 49363/29.97 = 1647.08 \text{ sec.} = 27 \text{ min.}, 27.08 \text{ sec.}$$

Film:

See Frame 11396. It takes 5 video fields to display 2 film frames. There are 2 video fields in each video frame and 29.97 video frames (pictures) displayed each second. The equation is as follows:

$$(2 \text{ film pic}/5 \text{ fields})(2 \text{ fields}/\text{pic})(29.97 \text{ pic}/\text{sec.})$$
$$*(X \text{ sec.}) = 2,880 \text{ film pictures}$$

$$(23.976 \text{ film pic}/\text{sec.})(X \text{ sec.}) = 2,880 \text{ film pictures}$$
$$X = 2880/23.976 = 120.12 \text{ sec.} = 2 \text{ min.}, 0.12 \text{ sec.}$$

Total running time for AVS:

$$\text{Video time} + \text{Film time} = 29 \text{ min.}, 27.2 \text{ sec.}$$

This calculation is off by two frames or .0667 seconds. There are two sections of this program where the video still frame starts on field two instead of field one. There were two frame counts lost in the field dominance changes. Those pictures are seen in real time but can not be accessed as still frames.

## Digital Audio for Video

### 1. Digital Audio Sampling Rate

The "normal" sampling rate for the Compact Disc audio format is 44.1 KHz. This sampling frequency works with both 50 or 60 Hz line frequencies. NTSC video operates on a 59.94 Hz clock instead of the 60 Hz line rate. Therefore digital audio locked to NTSC color video has its clock frequency altered to 44.056 KHz. The conversion between the two systems involves

slowing down the clock rate. Data bites are not normally converted, added or dropped. Timing becomes critical if material recorded at 44.1 KHz has to exactly match 59.94 video. Audio editing becomes necessary.

The 44.1 KHz digital audio that would eventually end up on the disc's analogue audio tracks was converted to the 48 KHz sampling rate required for the D1 audio channels and then stored on the D1 tape.

## 2. Digital Audio Mastering on a Video Disc

The PCM digital audio from the 3/4" Sony 1630 format tape is added to the 8 MHz video carrier (it is not modulated onto the carrier) before the video modulates the carrier. The PCM signal level is 26 dB below the level of the video carrier. See Figure 4. Filtering takes place so that the result of the addition is the PCM in the same RF spectrum space as it is found on a regular CD and the unmodulated video carrier. There can be specific noise patterns in the video, from the digital audio, if this filtering process is not set correctly. The video is then modulated onto the carrier. As a check of the process before mastering a disc, the digital audio can be switched on and off to make sure it is not interfering with the video.

In the player, a 1.7 MHz low pass filter is used to separate the digital audio from the analogue signals.

## 3. Digital Audio Production for Video

The D1 and D2 digital video record formats, and the Compact Disc audio record formats are currently the most popular ways of mastering digital audio for video. (There are some 1" analogue video recorders that can record digital audio.) Large editing suits, capable of handling the audio in an all digital format, will probably come into existence in the early 1990's.

D1 and D2 audio are not directly compatible with the CD or Laser disc distribution format. The laser disc is the only medium currently available to convey digital audio to the consumer. As a result, "A Video Standard" is probably one of the few programs available to take full advantage of the digital audio capability of the system.

# Demonstration Material

The digital audio demonstration material may seem to have more "punch" than is present on other videodiscs. That extra "punch" is real. Full advantage has been taken of the digital audio dynamic range.

## 1. Digital Audio Tracks in the Program

All of the music demonstration material in this program was taken from edited digital masters tapes. The digital integrity of the signal was maintained through out the entire disc program editing and master tape production process.

## 2. Analogue Audio Tracks in the Program

The CX decoding process in current videodisc players can be directly controlled from the disc, as is the case with this program. The disc instructs the player to turn the decoder on shortly before the end of Chapter Four, and turn it back off shortly before the end of Chapter Five. CX was added to the videodisc format to partially compensate for interference in the audio from the video signal. It is a modified version the CX system originally proposed by CBS for LP records. That system never gained favor with LP record distributors and was never implemented. The majority of the analogue audio in this disc is not CX1 encoded.

The CX system tends to flatten any image; front to back information, that might be present in the original audio. Being able to record significant image information in a two channel audio system is one of the many things that makes Reference Recordings' audio so special. The analogue audio should seem to "come alive" at the point where the CX encoding process is completely removed.

In the program mastering process, the actual switching of the analog CX Encoding was done manually from a cue provided in the video. The encode process switch point does not exactly coincide with the electronic switching signal for player decoder control.

Current disc mastering process minimizes the interference between the audio and video carriers, therefore minimizes the need for CX encoding.

## 3. Audio Elements of the Program

While much of the sound effects and dialog were digitally mastered, they had to be converted to the analogue domain to be mixed and edited, before being re-recorded in the digital format. Small portions of the sound effects originated in the analogue domain. Those were mastered in the new Dolby SR3 recording format for maximum compatibility with the digital sources.

All of chapters One and Two, and dialog and effects in Chapters Three and Four were mastered in Dolby Surround Sound2.

The sections music in this program are not Dolby Surround Sound2 encoded. That would have required taking the digital material back to the analogue domain for Dolby2 encoding. Even if that were possible, none of the material was originally mixed for the four channels; left, right, center, and surround, required for the Dolby Surround Sound2 encoding process.

The surround sound demonstration in this program is much more subtle than found in most motion pictures. Surround information is contained primarily in room ambience. There is fan noise in the control room, large hall ambience in the studio, and the over-head presence of the rotating blades in the opening of "Electronic Field Production". The dynamic range of the background to the foreground is very large in the first two chapters. It should test the limits of the audio playback system. Detailing some of the production process will assist in an appreciation of what is being heard.

The color bar crash in Chapter One serves as an example. In considering the crash sound, it is conceivable that each bar might have a different density; therefore have a slightly different pitch when it crashes. Assembling the audio started by recording a single crash to be used as the master for the sequence. The initial crash, recorded on a DAT master, was loaded into a synthesizer. Many different pitches of the crash were then "playable" on the keyboard of the synthesizer. A particular key, or pitch, was assigned to each color bar. As each bar came to a point of crashing, its associated key on the synthesizer was activated.

Use the frame by frame advance feature of the disc player to see that each bar crashes in its own time.

Now, go back to the beginning of the crash and listen carefully for the crash sounds occurring one after the other.

Many days of work went into producing the sound effects for this program; as would occur with any major production. The sounds are time sequenced on multi-track tapes, mixed down to the four channels that properly position the sound in space, set for level, then Dolby Surround Sound2 encoded to the two channel stereo audio system.

## Program Construction

In terms of the SPARS code used to indicate how a compact disc is put together, the video in this program would read "DDA".

### Video Source Material

Much of the video in this program originated in the digital domain and was recorded directly onto the Sony D1 Digital Video Recorder. The talk show studio shots in chapter 2 were first recorded in the composite digital video D2 format from the NTSC analogue output of the Philips LDK-6 camera. The D2 information was decoded back to the analogue domain, further decoded to Y, R-Y, B-Y, then transferred back to the component digital D1 format. The rest of the analogue video in this program originated in component form, either R, G, B or Y, R-Y, B-Y and was directly transferred to the component digital D1 format.

### Editing

Some of the D1 material was taken back to the analogue component domain to be routed through the Grass Valley 100CV Switcher. This was necessary because at the first stage of the editing process a component digital switcher was not available. Component material from the GVG analogue switcher was then transferred back to the digital domain for re-recording on the D1 program master tape. By the time the program was in its final editing stage, the Thompson component digital video switcher was available, allowing switcher effects to be accomplished in the digital domain.

The final "A" in the video "DDA" SPARS code comes from the video disc mastering machine requiring an analogue NTSC input. A Sony D1 machine was brought to the disc mastering

facility. The digital video was converted to an analogue RGB signal by the D1 machine. These three signals were then combined into an NTSC signal using the Grass Valley encoder. The NTSC video presented to the laser disc mastering modulator represents the very best quality an edited program can have.

## Audio

The audio in the program is a combination of recording processes. The narration, as an example, was digitally recorded, converted to analogue to be mixed in with the rest of the sound, and re-recorded in the Sony 3324 digital format. Much of the demonstration material on the digital audio track qualifies as "DDD". Great care was taken to keep digital originals in the digital domain where ever possible.

Dolby Laboratories generated most of the audio test signals in the digital domain. They were transferred directly to the program digital master.

The source audio for the disc's two analog channels was also edited to the Sony 3324 at the same time the digital tracks were constructed. Separate demonstration music was placed into these two channels from digital masters.

The two tracks on the Sony 3324 edited master tape, designated for the disc's digital tracks were converted to the Sony 1630 format. (This format is used for mastering CD audio discs as well as Laser Video discs.) The two tracks used for the disc's analogue audio were transferred to the D1's digital audio channels. The D to A converters in the Sony D1 provided the analogue audio used in the disc mastering process.

## Program Mastering

Most of the rules of videodisc program production, i.e., analogue audio levels, color saturation, video bandwidth, field dominance, etc., were broken in the process of mastering this program. Prior to mastering, significant advances were made at the mastering facility to accommodate our requirements.

## Disc Mastering at Disctronics:

Steps in disc mastering for CD's and Laser Discs are similar. The pictures shown in Chapter Five are a mix between CD and Laser Disc manufacturing.

The basic procedure is as follows:

1. Start with a circular glass plate and polish it to a very smooth finish.
2. Spin coat a thin even layer of photo resist on the glass and allow it to harden. The photo resist is sensitive to blue light, the color of the laser used to expose the disc.

The glass preparation and mastering areas are lit with yellow lights. Blue light in the room would fog the disc. Yellow light is white minus blue.

3. Recording the master disc: There are four channels of baseband information to be recorded; video, two analogue audio tracks, and digital audio. The PCM digital audio is added to the video carrier before the carrier is modulated with the video information. Each analogue audio channel is modulated on to its own carrier. The three modulated carriers are added together, hard limited, (turned into rectangular waves, rather than sine waves), and used to drive an acoustic-optical modulator that turns the laser beam on and off. The modulated beam of light then exposes the photo resist on the spinning glass plate. The recording process is analogue. The size of pits and pit spacing contain the information.
4. Once the disc is exposed, it is chemically processed to remove the resist in the exposed areas. This leaves the unexposed areas on the disc with resist and exposed areas without resist.
5. A very thin layer of metal is then vacuum deposited on the glass. The metal deposits into the "holes" created by the chemical processing of the photo resist. The disc is now playable. The first stage of Quality Control takes place at the master player.
6. After passing the first QC stage, additional metal is electroplated onto the original thin metal layer. This process continues until the metal layer is thick enough to be used as a stamper or a "mother" for additional stampers.
7. The metal is pulled away from the glass. At this point the surface of the metal has a lot of "bumps" on it, the opposite of "pits". It is then trimmed, punched and prepared for the stamping process.
8. The stamper is used in the injection mold machine to make plastic replicas of the disc. Hot liquid plastic is injected into a chamber containing the stamper. The plastic is allowed to solidify before it is separated from the stamper. This process is repeated many times, each time creating a single side of a videodisc. The process takes about two to three minutes per replica.
9. A thin coat of metal is deposited on the side of the plastic replica that contains the pits.
10. The metallized side of the plastic replica has a protective coating put over it.
11. Hot glue is applied to the protective coat.
12. Two pieces of plastic, both with the protective coating and hot glue, are bonded together.
13. The outside edges of the bonded plastic are trimmed to get rid of any product squeezed out in the bonding process.
14. Once the center label is applied, one to each side, the disc manufacturing process is finished. Completed discs are sampled for quality control checks.

Mastering of "A Video Standard", directly from a Sony D1 player, through a Grass Valley Encoder, first took place at Discronics in October of 1989. Ray Keating and Gilbert Perez were in charge of the mastering. Alan Bremner, Manager of Engineering and Development, and Alan Hamersley, Manager of Mastering, at Discronics, provided additional support.

Several subsequent masters were made as improvements to the mastering system occurred.

Disc Mastering and replication were moved to the Pioneer Facilities in Carson, California in 1990. They made significant improvements to their facility in order to accommodate AVS.

#### CD Manufacturing:

The process is similar right up to bonding the two sides together. A CD has a clear plastic back applied instead of a second side and the label is silk screened on the entire back surface instead of a paper label being attached to the center.

## References

There are a number of published works or sources of many published works that may be used to augment the information found in this disc. Some of them are as follows:

"Basic Television" by Bernard Grobe, Published by McGraw-Hill. Check for current edition.

"Illumination and Color in Computer Generated Imagery" by Roy Hall, Published by Springer-Verlag

"Introduction to the 4:2:2 Digital Video Tape Recorder" by Stephen Gregory, Published by Pentech Press

"Raster Graphics Handbook" Conrac Division/Conrac Corporation, Second edition, Published by Van Nostrand Reinhold

"Videodisc Systems Theory & Applications" by Jordan Isailovic, Published by Prentice-Hall

SMPTE: Send for a list of publications available from the address in Frame 20471. Included in this group are Instrumentation for Monitor Calibration by Joseph J. Kane, Jr. and the T14.28 Monitor Calibration documents plus many papers on basic television and film.

Tektronix Television Application Notes, Published by Tektronix, available from their Sales Offices. Many of these notes date back to the early 1970's and may be hard to find. Tektronix also published several books on television signal measurements.

Technology in television changes rapidly. Keeping current often requires attending conventions and conferences dedicated to video. The SMPTE and the National Association of Broadcasters (NAB) are two among many organizations that address the professional market. The Electronics

Industry Association (EIA) sponsors two shows a year called the Consumer Electronics Show, (CES).

## Credits

1 CX is a Trademark of CBS Inc.

2 Dolby®, Dolby® Surround Sound, & Dolby® Pro-Logic Surround Sound are Registered Trademarks of Dolby Laboratories, Inc.

3 Dolby® B & Dolby® SR, are Registered Trademarks of Dolby Laboratories, Inc.

4 Trinitron is a Registered Trade Name of Sony Corporation

5 Munsell Color, Macbeth, A division of Kollmorgen, 2441 North Calvert Street, Baltimore, Maryland 21218. Updated: <http://www.munsell.com/> and <http://www.cis.rit.edu/mcsl/>

6 Rosco, offices in Hollywood, New York, Toronto, London, Madrid, & Lisbon

"A Video Standard" is a production of  
Joe Kane Video Productions  
Joseph J. Kane, Jr. Executive Producer (JJK)  
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With audio from:  
Reference Recordings Ltd.  
J. Tamblyn Henderson, Jr. President (JTH)  
Marcia G. Martin, Marketing Director (MGM)  
Keith O. Johnson, Audio Engineering (KOJ)

## Program Production Credits:

Produced/Director: JJK  
Graphics: Joel Groch & Mark Dennison  
Control Room Sequence: Ron Williams, Mark Dennison, & JJK  
Control Room Facility: Telecine 2, TAV, Hollywood CA  
Studio Video Sequence: Paul Wise & Art Carter Jr.  
Field Production: Barry Enders & Bruce Rayner  
Film Consultation: Russell McMurtray  
Print & Negative Film: Motion Picture and Audiovisual Products Division, Eastman Kodak Company  
Film & Slide Transfer: Ralph Eck & Pat Kennedy  
Video Test Signals: Magni & Philips Generators  
Video Measuring Equipment: Philips & Tektronix

Audio Test Signals: Mark Davis, Dolby Laboratories & KOJ  
Music & Sound Affects: Kevin Braheny, JTH & KOJ  
Narration at Crystal Sound: John Morse & JJK  
Narration Recording: Kevin Braheny, MGM, & KOJ  
Script: Mark Sanford, John Morse, JJK, & MGM  
Still Photography: Kurt Shanaman, KAS Realities  
Program Titles: Dubner 20K Generator & JJK  
Additional Graphics: Conrac Display Products, Discronics Mfg. Inc., Photo Research, LeRoy DeMarsh, Eastman Kodak Company

## Program Post Production:

### Video

Program Editing: Mark Humphrey  
Editing Facilities: AME, Inc. Burbank CA  
    Sony DVR 1000 D1 Tape Recorders,  
    Grass Valley Group (GVG) 100CV Switcher,  
    Dubner 20K Character Generator from GVG,  
    GVG Edit System  
Technical Assistance: Bob Bajorek & Jan Yarbrough  
Insert Edit: Eldon Phillips  
Insert Facility: Composite Image System, Hollywood CA  
Betacam Video Editing: Terry Pickford  
Betacam Edit: Sony BETACAM SP Video Recorders,  
    GVG "Kaleidoscope" & GVG Edit system at  
    Action Video, Inc., Hollywood CA  
Equipment Loan: Dubner 20K and GVG 100CV Switcher;  
    Courtesy of Grass Valley Group, Grass Valley CA

### Audio

Affects Editing: Keith Bilderbeck, Kevin Braheny, & KOJ  
Audio Demonstration Editing: JTH  
Opening and Closing Editing: Kevin Braheny & KOJ  
Program Re-Mix Editing: Doug Davey & Chris Haire  
Audio Tape Operation: Guy Tsujimoto & "Tomi" Tomita  
Dolby Print Master Supervision: David Gray & Doug Greenfield  
Editing Facility: Modern Sound at Modern Videofilm  
Digital Audio Transfer: KDISC Mastering, Ken Perry

### Disc Mastering

Discronics: Alan Hamersley, Ray Keating  
Sony D1 Player: courtesy Sony Communications Products Company, Bruce Lilly

# Album

Cover: Morgan Wesson, JTH, & JJK

Blue Filter: Russell McMurtray, Don Nikkinen, Image Transform, Gary Hoonsbeen, DRT Corporation, & JJK

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Book II: Proof, Edit & Assembly help; Russell McMurtray, Ray Keating, Demian Martin, KOJ, & MGM. Written by JJK, Copyright JJK 1990

## Distribution up until 1998 when the product was discontinued

Reference Recordings Ltd, Box 77225X, San Francisco, California 94107

MGM, & Janice Mancuso. <http://www.referencerecordings.com/>

Joseph J. Kane, Jr. 5 August 1990

Reorganized on 12 July 2004

