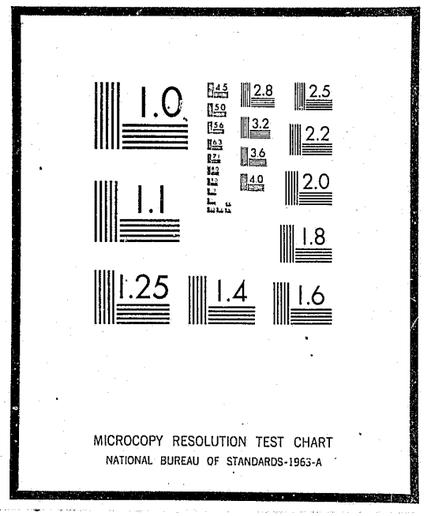

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VIDEO SUPPORT IN THE CRIMINAL COURTS

VOLUME II

Users Guide to Performance Standards and Equipment Costs

Prepared by the National Center for State Courts

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CONTENTS

		Page
	ABSTRACT	
	PREFACE	i
I.	INTRODUCTION	1
II.	PERFORMANCE REQUIREMENTS/EQUIPMENT FEATURES	3
	A. Recommended Performance Requirements	3
	B. Recommended Equipment Features	5
	1. Equipment Standardization/Compatibility	5
	2. Assurance of System Operation	7
	3. Easy Recognition of Tampering	9
	4. Faithful, Clear, and Easily Understandable Video and Audio Reproduction	11
	5. Summary of Recommended Equipment Features	18
III.	VIDEO SYSTEM COSTS AND VENDOR SERVICES	21
	A. Vendor Recording and Rental Charges	21
	B. Video System Configuration Examples	23
	C. Video Equipment Purchase Prices	32
	1. Videotape (1/2 Inch, EIAJ-1)	32
	2. Video System Components	37
IV.	DESCRIPTION OF VIDEO SYSTEM EQUIPMENT	48
	A. Equipment Characteristics	48
	1. Video Cameras and Accessories	48
	2. Lenses	51
	3. Monitors and Receiver/Monitors	53
	4. Video Tape Recorders	54
	5. Special Purpose Video Components	61
	6. Microphone and Mixer	64
	7. Production Control Console	66
	B. Effect of Application/Environment on System Selection	67
	C. Maintenance Procedures	69
	D. Storage and Shipping of Videotape	71

FIGURES

FIGURE NO.		PAGE
1	Grounding High Impedance Input Using Two Conductor Shielded Cable	16
2	Vidicon Image Tube	48
3	Typical Range of f Stops	52
4	Angle of View Compared to Lens Focal Length	53
5a	2:1 Interlace	62
5b	Random Interlace	62
6	Microphone Pickup Patterns	64

TABLES

TABLE NO.		PAGE
1	Vendor Recording Services: Range of Rates	25
2	Vendor Equipment: Rental Charge Formulas	26
3	Vendor Equipment: Range of Rental Charges	27
4	Pre-recorded Depositions/Testimony: Single Camera, Single Microphone System (On Location or Studio)	28
5	Pre-recorded Depositions/Testimony: Multicamera, Multi-microphone System (Studio)	28
6	Pre-recorded Evidence: Single Camera, Single Microphone System (Portable)	29
7	System for Editing Pre-recorded Videotape Prior to Trial	29
8	RF Playback of Pre-recorded Videotape	30
9	Courtroom Recording System: Without Special Effects	31
10	Courtroom Recording System: With Special Effects	33
11	Courtroom Recording System: Without Special Effects, But With Playback Capabilities	34
12	Commercial Discounts Available For 1/2 Inch, EIAJ-1 Videotape	35
13	Government Contract Price For 1/2 Inch, EIAJ-1 Videotape	36
14	Industrial Consumer Net Price For 1/2 Inch, EIAJ-1 Videotape	36
15	Selected Listing of Currently Available Off-the-shelf Video System Equipment	38

ABSTRACT

This is the second of a four volume work entitled Video Support in the Criminal Courts. It offers the potential court user recommendations concerning video system performance requirements and equipment features. This volume is especially useful to courts promulgating video recording rules and procedures, and court administrators involved in equipment selection. It summarizes video system components, their relationships, and availability. Discussion includes recommended maintenance, storage, and handling procedures, and the effects of environment on system selection. This volume analyzes available vendor services, gives examples of recommended video system configurations for specific legal recording applications, and lists specific brands of equipment likely to be considered when selecting a video system.

I. INTRODUCTION

While securing video applications to clarify the legal issues and procedural problems surrounding use of video technology in criminal courts, much experience was compiled concerning video equipment useful to courts. Project design included a systematic inquiry into: available video hardware and vendor services; the legal environment in which video technology would be applied; and video equipment operating characteristics and features most suitable for court related recording. The information thus obtained has been analyzed and used to prepare this Users Guide to Performance Standards and Equipment Costs.

This Users Guide has been prepared to give court decision makers, such as courts with rule-making authority and court administrators involved in equipment selection, sufficient familiarity with equipment and operating considerations to allow knowledgeable decisions to be made when promulgating rules and procedures regarding video recording, and when selecting and using video systems. Probably the most important feature of this volume is inclusion of a set of recommended performance requirements and equipment features needed for video recording in the legal environment. These recommendations allow the user to properly subordinate the selection and use of video equipment to the legal community's objectives for such recording.

The size of the volume does not allow room for full explanation of every technical term used. Many electronic or in-trade terms are not defined herein; detailed explanations for such terminology can be found in Volume IV (Equipment Technical Analysis and User Experience) of this

report, which gives the reader a more detailed discussion of video system components, features, operating characteristics, and environmental and system design considerations. Discussion of the project recording experience base from which these recommendations are drawn is left to Volume I (Project Summary) of this report.

The material presented in this Users Guide to Performance Standards and Equipment Costs is important because it will affect the quality of video recording production. This quality, in turn, will affect the responses obtained from participants as well as from appellate courts; these appellate courts will ultimately determine the legal acceptability of and procedural requirements for such recording, and as such should see video recorded products at that level of quality which most accurately demonstrates the potential of the medium.

II. PERFORMANCE REQUIREMENTS/EQUIPMENT FEATURES

A. Recommended Performance Requirements

For a video system to have value, after it has met the legal requirement of not interfering with an individual's rights by its use, it must be able to produce a true and accurate reproduction of what occurred. This becomes the objective of video recording in the legal environment. This objective can be achieved through development of a series of performance requirements for video equipment used in legal applications. Such performance requirements must not only take cognizance of the technical aspects of achieving a true and accurate recording, but must also encourage development of a practical and cost-effective implementation mechanism for transfer of videotapes and equipment between users.

Experience gained during the Video Demonstration Project provided valuable comparisons and working knowledge of video component types and brands, and their particular uses for legal applications. This experience, coupled with guidance and commentary from the project's Video Advisory Committee and other members of the legal community, has aided project staff in identifying equipment performance requirements which would best meet the overall objective for video recording in legal applications. Recommended performance requirements are:

* Equipment Standardization/Compatibility. A tape produced on one system must be able to be played back on other systems, even other manufacturer's systems, and system components must have a degree of interchangeability between systems. This approach allows practical and cost-effective transfer of videotapes and equipment between users.

* Assurance of System Operation. The equipment must provide assurance to the operator that what is occurring is being preserved on videotape. This offers an ongoing measure of system reliability and accuracy.
* Easy Recognition of Tampering. The system must produce a videotape in which unauthorized changes are easily recognized. This provides security for the medium, and preserves its integrity.
* Faithful, Clear, and Easily Understandable Video and Audio Reproduction. The system must faithfully record and play back an event at a quality level that assures production of a videotape with clear and easily understandable video and audio information. This is a measure of the trueness of the produced videotape.

1/2 inch EIAJ-1 format is recommended for adoption by court users, not because of a superiority in format, but because 3/4 inch VTRs currently available do not possess features necessary to meet stated performance requirements, as will be seen in the ensuing discussion.

A survey of available equipment in the 3/4 inch and 1/2 inch formats showed that both formats include video tape recorders with color and black and white recording capability. The 1/2 inch EIAJ-1 color VTRs cost only a few hundred dollars more than comparable black and white VTRs, while all 3/4 inch cassette VTRs possess color capability because they were originally designed for consumer use and off-the-air recording. A close look at color cameras, for either format, reveals operational characteristics which do not lend themselves to legal application usage. Not only are color cameras five to ten times as expensive as black and white cameras, but they also require accurate adjustment, an extensive amount of light, and certain types of light for accurate and consistent color reproduction. Although this lighting can easily be set up in a studio situation, it is likely to be extremely distracting if recording courtroom proceedings. Because of these drawbacks, it is recommended that legal community users standardize on black and white reproduction.

2. Assurance of System Operation

An unnoticed equipment failure may mean the loss of invaluable criminal testimony or evidence. The state of the art of common format (3/4 inch cassette or 1/2 inch EIAJ-1) video tape recorders does not provide for monitoring video or audio signals during recording. For courts, this lack of output monitoring capability is a serious inadequacy; however, signal strength meters, for both video and audio signals, should provide reasonable assurance during recording and playback that all system components are working properly. Testing of the system prior to recording should provide further assurance that the system is working at that time.

A video signal strength meter on the VTR is the only discrete means available for checking the video components of a system while recording. Although problems with video components seldom arose during project applications, when they did the video signal strength meter gave the first indication. During one experiment in video recording court proceedings, many lights in the courtroom ceased to function between recording sessions. This was noticed by the operator when the video strength meter registered below the optimum level. True, the program monitor/receiver also displays a loss of video signal, but it is not as discrete a method of comparison as a video signal strength meter.

None of the 3/4 inch cassette VTRs and only three brands of 1/2 inch EIAJ VTRs incorporate the video strength meter feature. Two of these (Panasonic and Concord) include in their VTRs one signal strength meter, which is switchable from audio to video. This

arrangement, although better than no meter, requires the operator to continually switch between signals to adequately monitor both video and audio signals. Often an operator will be too busy with other functions to perform this system breakdown. The other brand incorporates a separate video signal strength meter into one of its VTRs (Sony AV3650); the meter in this machine's video circuitry is located just before the record head amplifier. This location provides strong assurance that the video components in the system are working properly. Because of this feature, the Sony AV3650 should be given strong consideration when selecting a VTR for legal applications. It should be noted that another machine, although not available at this date (Panasonic NV3150), will include a separate video signal strength meter with its features.

In a multi-microphone system, the audio mixer should include a signal strength meter, individual microphone level controls, and a headphone output. These features enable the operator to monitor the incoming audio signal and set the relative volume of each microphone as needed. Examples of mixers with these features are the Shure M67 and Sony MX900. In addition, an audio signal strength meter on the VTR provides the same type of assurance that audio components are functioning properly as does a video signal strength meter in the VTR for video components. As of this date no 3/4 inch cassette VTR includes an audio signal strength meter; almost all 1/2 inch EIAJ-1 VTRs incorporate this feature.

The need for these audio features has been demonstrated many times during the project. In project recording situations where the

presence of considerable background noise did not permit use of AGC, the headphone and calibrated signal strength meter on the audio mixer were both used to alter microphone volumes when participants raised or dropped their voices suddenly. The audio signal strength meter on the VTR was used when setting up a system to help select microphone placement and locate noise or interference, and during recording to insure acceptable audio input signal strength to a point just before the record head. Further, location of control equipment often will not permit use of a program monitor/receiver to check microphone volume because of acoustic feedback problems or proximity to participants; use of the meters is mandatory in this situation. To illustrate, during one such recording constraint a microphone was not turned back on after off-the-record discussion; this was noted immediately by the equipment operator by viewing his audio signal strength meters.

3. Easy Recognition of Tampering

Use of an internal (on the videotape itself) timing device in the video system will insure that any tampering with the video record will be easily recognized. An internal timing device will also provide a system-independent indexing source that will insure that information recorded on one system can be easily referenced when played back on the system of another manufacturer. Also, when editing pre-recorded material, use of an internal timing device provides a more accurate means of indexing edit points than a VTR counter.

In single or even two camera studio applications, a single background clock with a clearly visible sweep second hand can provide an always-in-the-picture internal timing device. This method, however, becomes

inadequate for many applications because camera movement or switching will take the clock out of the recorded picture, thereby losing the reference base. Use of an external video component, a time/date generator, will overcome this potential problem by superimposing a display of the date and time the recording is taking place onto the recorded scene. Variable placement of the display is available on some generators, such that it can be put at the very top or bottom of the monitor screen, or even in the blanking signal (there may not be enough room in the blanking space for character sizes of some time/date generators (an example of one that provides both variable character size and placement is the Odetics VTG-33.

Video production during the project showed the usefulness of a time/date generator. During the video recording of a trial in St. Johnsbury, Vermont, a log of important events (objections, etc.) was made using the digital counter on the recording VTR, a Sony machine. During duplication it was discovered that the digital index of Panasonic machines differed from those of Sony (a Sony VTR and Panasonic VTR were used together to duplicate). Consequently, this log was not accurate whenever played back on a non-Sony machine (all VTR counters exhibit this lack of interchangeability, unless two brands are made by the same manufacturer). A duplicate log had to be made and indexed to the Pansonic digital counter. The use of a time/date generator in later video production eliminated this type of problem.

As another example, editing of pre-recorded testimony during the early stages of the demonstration project involved indexing edit points to the last word of the last acceptable material before an edit and to

the corresponding number on the digital counter of the VTR. This process was time consuming because of digital counter inaccuracy. In later edits a time/date generator provided a more accurate (to-the-second) log of the index point, saving much editing time.

4. Faithful, Clear, and Easily Understandable Video and Audio Reproduction

Faithful production is of utmost importance in the legal use of video technology. The presence of interference in the audio or video portion of the tape is tiring to the listener, and may cause confusion and distortion of a recorded event. Moreover, the loss of vital information because of video noise or audio distortion could cause error in trial proceedings and delay criminal case processing. Recording systems used for legal applications must have features that will assure a production that is a true, clear and easily understandable reproduction of both the video and audio portions of an event.

The video components of a system must combine to produce the best possible picture. Since a sync source (control signal for camera) with 2:1 interlace will generate a more detailed video picture than one with random interlace, it is recommended that a 2:1 interlace common sync source be used. In a single camera system, this recommendation can be satisfied by means of a 2:1 interlace sync signal internal to the camera or directly from the VTR. Examples of cameras which have 2:1 interlace internal sync are Panasonic WV241P and Sony AVC3210.

For multicamera operation, the sync source must be common to all cameras. If it is not, as was the case during one recording application early in the project, switching between two self-driven cameras with internal 2:1 interlace sync will cause interference, called "glitching"

and possible "vertical roll". This problem is eliminated by using a common sync source, such as a discrete component sync generator or a VTR with an internal sync generator and switcher to disperse it. Examples of cameras which will accept external sync (from a common source) are GBC CTC5000, Sony AVC3210/AVC3200, and Panasonic WV240P/WV241P/WV250P.

No 3/4 inch cassette VTRs are equipped with an internal sync generator. Some 1/2 inch EIAJ VTRs have an internal sync generator (examples are Sony AV3650, Javelin X400, JVC KV360), and have 2:1 interlace (an example is Shibaden SV510DV). For VTRs without internal sync, an external sync generator can be used as a common source. Examples of 2:1 interlace EIA (Electronic Industries Association) external sync generators are the GBC SG201, Sony CG1, and Panasonic WJ120P.

Another feature which is recommended for inclusion in the video system is manual override for video automatic gain control (AGC) in the VTR circuitry. Manual override of video AGC is useful in high contrast situations to obtain detail of dark subjects in a scene. The video AGC is designed to compensate for variance in scene illumination and will alter the video signal strength to maintain a constant, average light level. Problems can arise with the use of the video AGC because darker areas of a scene may not record clearly. For example, in a scene with a black subject in front of a sunlit window or other bright, larger background, the AGC will adjust the video signal such that the black subject will lose detail and will appear as a silhouette. Facial expression and recognition will be lost to the viewer. By manually

altering the video gain on the VTR, the operator can improve the picture detail of the darker subject, but at expense of sacrificing the quality of the lighter background (this will appear washed out). It should be noted that video AGC will work well in an evenly lit room that does not have extraneous light. Problem lighting could be eliminated when selecting or designing a room for video use, eliminating the need for manual override of video AGC. However, some applications of video technology, specifically pre-recorded depositions/testimony and pre-recorded evidence may often require operation in high contrast environments; for this reason, a manual override feature for video AGC is emphasized.

Experience in video recording during the project reinforces the need for manual override for video AGC. During the video recording of trials in St. Johnsbury, Vermont, and Kansas City, Missouri, facial expressions of courtroom participants were degraded when using the video AGC by the introduction of bright light through a thinly shaded window. When manual override for the video AGC was used, this situation improved. A similar problem occurred during video recording of lineups in New York City; again, the use of video manual gain control helped control the situation.

To date, all 3/4 inch cassette video tape recorders have only automatic video gain control; some 1/2 inch EIAJ-1 VTRs with manual video override are: Panasonic NC3020SD, which has manual override capability for video AGC but no Video Signal Strength meter; Panasonic (NV3120), which has Video AGC and manual override, with switchable (able to select either video or audio, one at a time) signal strength meter; Panasonic NV3130, which has manual video gain control, but

no video AGC; and Sony AV3650, which includes manual override for its video AGC and has a video signal strength meter.

Another area of concern affecting video reproduction quality is the effect of edits and the effect of stops, pauses, and re-starts during the recording.

If editing capability is required for the video system, a VTR with a Capstan Servo Control is recommended, to minimize "glitching" and "roll" at the edit points. These forms of video noise are otherwise unavoidable. Even in non-editing applications, simply entering or re-entering a tape after a stop during recording will cause glitching and roll unless the VTR has Capstan Servo Control. Editing done during the video demonstration project using a non-Capstan Servo Controlled VTR showed brief loss of video quality during the edit. Proper use of a Capstan Servo Controlled editing VTR eliminated most of the problems. To date, no 3/4 inch cassette VTR includes Capstan Servo Control; only one 3/4 inch cassette VTR includes an editing feature. EIAJ-1 VTRs, on the other hand, are available with Capstan Servo Controlled editing. Examples of 1/2 inch EIAJ-1 VTRs with this feature are the Panasonic NV3130 and Sony AV3650.

In a legal-use oriented video system, audio lapses, distortion, or interference can easily negate any quality gains made in the video portion of videotape. Audio which is clean of interference, complete in its coverage, and clearly understandable is the other, essential half of a video recorded production. Experience gained during the project helped identify those audio component features herein recommended as necessary for good audio reproduction.

Audio hum and pickup interference, introduced by unbalanced audio cable lines, plagued many early video project productions. Through trial and error and consultation with audio engineers, alterations were developed which eliminated these problems and greatly improved audio quality. The use of low impedance, balanced line microphones is recommended in single or multi-microphone video systems whenever microphone cable length exceeds approximately 20 feet. Exceeding the 20 foot length with an unbalanced line permits interference such as hum and pickup to enter the audio circuit. Low impedance balanced line microphones help to insure against extraneous audio interference.

A problem arises in compatibility between low impedance, balanced line microphones and many video tape recorders. Most VTRs accept high impedance, unbalanced line audio input; most high impedance microphones are unbalanced. Some VTRs (e.g. Sony machines) do use low impedance microphone or line inputs; however, these inputs are also unbalanced. The use of unbalanced line audio inputs in standardized video tape recorders is a serious impairment to many courtroom video productions. Nonetheless, balanced line microphones can be used if the balanced line is terminated prior to entering the VTR (Figure 1); this approach is recommended. Also, through the use of an impedance matching transformer, low impedance audio lines can be changed to high impedance, for use with VTRs with high impedance input. This approach is recommended to eliminate hum and pickup problems while keeping audio signal strength at an optimum level. For multi-microphone systems, hum and pickup problems are eliminated by running balanced line microphone cables to the audio mixer, and running an impedance matched, short, unbalanced line from the mixer to the VTR.

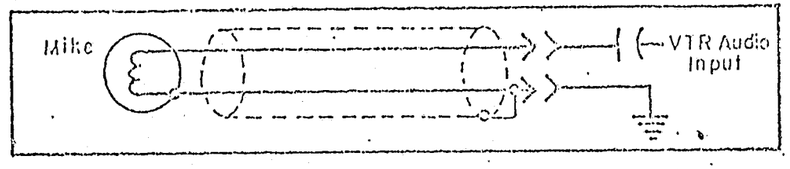

Figure 1 Grounding high impedence input using two conductor shielded cable

Low impedance balanced line microphones are readily obtainable from many manufacturers; some examples are Electrovice 635A/1751, Shure 533SB/579SB/SM60, and Turner 35A/230. An example of an impedance matching transformer is the Shure A95P.

Another audio component feature recommended for use in video systems to insure faithful and clear reproduction is manual audio level control or manual override capability for the audio AGC on the VTR. Manual override for audio automatic gain control enables the operator to keep the audio AGC from emphasizing extraneous noise during quiet moments of recording. An audio AGC circuit in a VTR is designed to compensate for variance in sound picked up by a microphone(s). It does this by automatically boosting the signal strength of the audio during quiet periods, thereby assuring that lower signal strength sounds are recorded. Problems arise when the audio AGC emphasizes extraneous sound such as rustling of papers, passing airplanes and

traffic and air conditioner fans, to a point of distraction. Even more serious would be the boosting and subsequent recording of an "off the record" whispered conversation between counsel and client or counsel and judge.

It should be noted that an automatic gain control will work well in a quiet, controlled, recording environment; however, project experience with video recording in the legal environment indicates that such controlled environments are few and far between. During one pre-recording of expert witness testimony, the audio AGC picked up, amplified, and recorded noise of an airplane flying overhead and cars going down the street. In another instance, use of audio AGC during the recording of a trial caused emphasis of siren noise to such extent that it was pointed out as annoying by members of the project's Video Advisory Committee. In yet another instance, the air conditioner in one moot courtroom, which was designed for video equipment, was so noticeable that the audio AGC had to be eliminated and lavalier microphones used.

These potential problems are avoided by using a VTR with manual audio gain control or manual override for automatic gain control. The audio level can then be controlled by using the signal strength meter as a measure of loudness. The equipment operator will have to pay more attention to his manual level control and audio signal strength meter when using the manual system; care must be taken to assure that the audio signal strength meter does not go into the "red" causing distortion when a speaker gets very near a microphone. Another important use of manual override of audio AGC is while duplicating; unless manual gain is used, all noise included on the original tape will be boosted by the audio AGC of the duplicating VTR, and the duplicate videotape will contain more noise than the original.

To date, no 3/4 inch video cassette VTRs incorporate manual override for audio automatic gain control; some of the 1/2 inch EIAJ-1 VTRs include this feature. Examples are: Panasonic NV3020SD and the NV3120, which have manual override for audio AGC; Panasonic NV3130, which employs only manual audio gain control; and Sony AV3650, which has manual override for its audio AGC.

5. Summary of Recommended Features

For reference, each of the foregoing recommended equipment features is listed under the relevant recommended equipment performance requirement. This list is intended as a guide for the legal-oriented video user when selecting system components:

Performance Requirement	Recommended Feature
a) Equipment Standardization/ Compatibility	1) 1/2 Inch EIAJ-1 Format 2) Black and White Reproduction
b) Assurance of System Operation	1) Video Signal Strength Meter on VTR 2) Audio Mixer Signal Strength Meter, Individual Microphones, Level Controls, and Headphone Output (for multi-microphone operation) 3) Audio Signal Strength Meter on VTR
c) Easy Recognition of Tampering	1) Internal (on videotape) Timing Device
d) Faithful, Clear, and Easily Understandable Video and Audio Reproduction	1) 2:1 Interlace, Common Sync Source 2) Manual Override for Video AGC on VTR 3) VTR with Capstan Servo Control 4) Low Impedance, Balanced Line Microphone (for cable lengths over 20 feet) 5) Balanced Line Termination Prior to entering VTR. 6) Impedance Matching Transformer (for high impedance input to VTR) 7) Manual Audio Level Control or Manual Override for Audio AGC on VTR

Evaluating existing VTRs in terms of their ability to meet recommended performance requirements through possession of the above features, it becomes necessary to disqualify 3/4 inch cassette VTRs from selection consideration because of their lack of: individual video signal strength meter, individual audio signal strength meter, manual override for video AGC, capstan servo control, and manual audio level control or manual override for audio AGC.

Several 1/2 inch EIAJ-1 VTRs meet most of the needed features, but to date none include all the features recommended. The Sony AV3650 includes all but one feature (2:1 interlace); this VTR includes: individual video signal strength meter, audio signal strength meter, manual override for video AGC, capstan servo control, and manual override for audio AGC. The Sony AV3650 also includes an internal sync souce capable of driving multiple cameras, and has low impedance audio input. Because of this input, an audio impedance matching transformer is not needed; a direct connection with low impedance microphones can be used. Since this VTR has unbalanced audio inputs, any balanced cable line from microphones (for use with cable lengths over 20 feet) must be terminated prior to entering the VTR.

Panasonic and Concord also manufacture VTRs which have many of the recommended features. The Panasonic NV3120 and NV3130 color or black and white VTRs include most key features but do not possess an internal sync generator or 2:1 interlace (nor automatic gain controls, in the case of the NV3130). These machines also possess only one signal strength meter which is switchable between audio and video.

To insure that both the audio and video components are working properly, the operator must switch between audio and video while watching the meter.

The most commonly lacking features on other VTRs are level meters for audio and video, and manual override for automatic gain control for audio and video.

III. VIDEO SYSTEM COSTS AND VENDOR SERVICES

The prospective court-related video user should have a good grasp of the video recording costs to be incurred and the equipment configurations needed for specific legal-oriented applications. The following discussion provides information which summarizes: commercial video recording firm services and costs and commercial video equipment rental costs; the type and purchase cost of components needed in a video system configuration for specific legal-oriented applications (pre-recorded depositions/testimony, pre-recorded evidence, recording of proceedings), under different operating conditions; purchase costs for 1/2 inch videotape for the EIAJ-1 format previously recommended; and the purchase cost of certain video equipment.

Comparative cost of video recording versus other forms of recording is not furnished because such a cost-effectiveness comparison is beyond the scope of this project. A cost-effectiveness comparison between alternative recording mediums, to be fair, will require analysis in several representative court systems over an extended period; in this semi-controlled environment, the analysis must measure actual court system costs, and impacts to participants. Until such time, the reader must make his own evaluation of the value of video recording versus its costs, relative to other available mediums. This discussion offers "ball-park" cost information only, and should not be used as a base from which to make cost-effectiveness comparisons.

A. Vendor Recording and Rental Charges

During the Video Demonstration Project information and cost data were collected on recording services and equipment rentals for some thirty video vendors. Equipment lease arrangements were also investigated;

these often unavailable lease arrangements are usually designed to recover total purchase cost of equipment over a 9-12 month period, with a lease period of at least one year. This schema strongly encourages outright purchase for all but the occasional user. Generally, video vendors concentrate either on hardware (selling equipment) or software (selling production services), but some will do both and will rent equipment as well.

Vendors often lacked in-depth knowledge of equipment, even purely hardware vendors. Specific information about equipment operation and inter-brand compatibility characteristics often had to be obtained through trial and error while setting up court-related video recording applications. Queried as to why he had such superficial knowledge of his video equipment, one vendor replied that he didn't need to know a great deal about each component he sold or used because he experienced few breakdowns in the equipment, and because user systems typically stay with one brand to avoid match-up problems. He added that with such rapid technological change, it was hard to keep abreast of the field. This response has been borne out by other vendors, but none could furnish reliability and maintenance figures to support the low breakdown assertion. Even more disconcerting was the fact that early in the project, only a few vendors were familiar with the legal community and its recording needs. This situation is changing; a number of software oriented firms are coming into existence around the country to accommodate the special recording needs of legal users. These offer video recording as a supplement to or in lieu of the traditional typewritten medium, but at widely varying rates.

To give a potential legal user a feel for the current structure and range of rates for commercially supplied video recording services and equipment rentals, three examples have been prepared. Table 1 reflects normal video services offered to legal users and the low to high charges for each. The rates shown are average composites derived from rate structures of video vendors from around the country. Table 2 reflects four common formulas used by some vendors when setting rental charges for video equipment; these illustrate the rapid recovery of purchase cost built into rentals for this type of equipment. Table 3 selects specific video components a legal user might rent, and then gives the average composite, low to high charges he might encounter for each. The figures at Table 3 reflect actual dollar quotes given by vendors; these vary from Table 2 percentages because, while some vendors use a cost formula, others use a set dollar charge based on other pricing considerations. This again illustrates wide variability in pricing.

B. Video System Configuration Examples

Listed at Tables 4 through 11 are eight video system configuration examples; these have been designed to give the potential legal user an example of the types and purchase costs of video components necessary to complete specific legal applications. The examples meet the performance requirements discussed earlier for court related video recording and give an overall view of video system costs and configurations needed for given applications. Brands listed in each example are used to illustrate a coordinated set of components which meets performance requirements; specific brand selection is left to the user.

Table 4 represents a typical single camera, single microphone system which could be used to pre-record depositions/testimony. The system is compact (could be taken to a remote recording location), and can be operated efficiently by one person. Table 5 represents a multicamera, multi-microphone system for recording depositions/testimony. The system is more sophisticated than the one at Table 4, is designed for studio usage, and would require two operators during most recording sessions. Table 6 describes a single camera, single microphone system designed to pre-record evidence such as confessions or line-ups. The system is compact and can be operated effectively by one person.

Table 7 represents a system designed to Assemble edit pre-recorded depositions/testimony or evidence; it can be operated by one person. Table 8 describes a system designed for courtroom playback of pre-recorded depositions/testimony or evidence. Operated by one person, this system uses one 11 inch monitor/receiver for the judge, one 23 inch monitor/receiver for counsel and public, and two 23 inch monitor/receiver for the jury.

Table 9 represents a system designed to record trial proceedings as the official record. The system uses three cameras in the courtroom; one camera to show judge and witness, one camera to show the counsel area, and one remotely controlled camera to show close-ups and activity outside the fields of the other two. A fourth camera could be placed in the judge's chambers for "on the record" conferences away from the jury. This system is designed for remote selection of the camera which best describes what is occurring in court. This system can be operated by one person.

TABLE 1

VENDOR RECORDING SERVICES: RANGE OF RATES

a) Recording Rate (local, includes equipment, personnel)

1) Studio (does not include video tape):

First Hour	Each additional 1/2 hour	Per day (8 hours)
$35-$250	$15-$75	$280-$1200

2) On Location (does not include travel expenses or video tape):

First Hour	Each additional 1/2 hour	Per day (8 hours)
$90-$150	$25-$87	$360-$580

b) Playback Rate (includes equipment, personnel)

$35 per hour

$50-$100 per day

c) Dubbing Rate (includes equipment, personnel, not video tape)

$20-$30 per hour

d) Editing Rate (includes equipment, personnel, not video tape)

1) Studio: $25-$35 per hour

2) On Location: $75-$100 per hour

*Note: Varying rates may reflect differences in quantity and quality of of equipment or personnel.

TABLE 2

VENDOR EQUIPMENT: RENTAL CHARGE FORMULAS

Formula 1:
1 day = 5% of purchase price
1 week = 3 days charge
1 month = 10 days charge

Formula 2:
1 day = 7% of purchase price
2 days = 12% of purchase price
3 days = 13% of purchase price
(add 1% each additional day)

Formula 3:
1 day = 5% of purchase price
2 days = 10% of purchase price
3 days = 15% of purchase price

Formula 4:
1 day = 4% of purchase price
2 days = 1/2 of 1st day charge + 1st day charge
3 days = 1/2 of 1st day charge + 1st day charge + 2 day charge
1 week = 3 day charge

TABLE 3

*VENDOR EQUIPMENT: RANGE OF RENTAL CHARGES

ITEM	1 DAY	2 DAYS	3 DAYS	4 DAYS	5 DAYS	6 DAYS	1 WEEK
1/2 inch VTR without edit	$40-$60	$60-$103	$80-$111	$100-$120	$100-$124	$100-$130	$100-$160
1/2 inch VTR with edit	40-87	60-149	80-191	100-174	100-187	100-210	100-251
3/4 inch Cassette VTR	60-105	90-180	130-225	130-225	130-225	130-240	130-255
3/4 inch Color Recorder/Player	75-107	112-182	150-198	187-213	187-228	187-262	187-321
Camera, B&W, with viewfinder, lens/tripod	35-58	52-99	70-107	87-116	87-124	87-138	87-174
B&W Receiver/Monitor 19-23 inch	15-21	22-36	30-39	42-42	42-45	42-49	42-62
Color Receiver/Monitor 12-23 inch	20-59	30-102	40-110	50-119	50-127	50-146	50-179

*Note: Charges vary in accordance with actual component cost and any special features included therin.
Charges do not include tape cost or labor.

TABLE 4

PRE-RECORDED DEPOSITIONS/TESTIMONY: SINGLE CAMERA,

SINGLE MICROPHONE SYSTEM (ON LOCATION OR STUDIO)

Quantity	Item	Unit Cost	Total Cost
1	Sony AVC 3200DX Unit (includes tripod, viewfinder, zoom lens, microphone, and camera.	$ 830	$ 830
1	Odetics VTG-33 Video Timer with year, month, day, min., second, variable positioning	850	850
1	Sony AV3650 Video Tape Recorder	1245	1245
1	Sony PVM9200, 9 inch Portable Monitor/Receiver	225	225
	TOTAL		$3150

TABLE 5

PRE-RECORDED DEPOSITIONS/TESTIMONY: MULTICAMERA,

MULTI-MICROPHONE SYSTEM (STUDIO)

Quantity	Item	Unit Cost	Total Cost
1	Sony AV3650 Video Tape Recorder	$1245	$1245
2	Sony AVC3200 Cameras	425	850
1	Sony AVF3200 Viewfinder	216	216
2	Quick-Set 4-73010-7 tripod	105	210
2	Quick-Set 4-72011-6 friction head	40	80
2	Sony VCL1206 Zoom Lens 12.5 - 75mm, f1.8	245	490
1	Sony VCS-31 Camera Switcher	55	55
2	Sony CVM112 11 inch Monitor/Receiver	275	550
1	Odetics VTG-33 Video Timer with year, month, day, hour, second, and variable positioning.	850	850
1	Shure M-67 Microphone Mixer	162	162
3	Electrovoice 635A omni-directional low impedance Microphones with balanced line	46	168
3	Shure S55P Isolation Desk Stands	29	87
	TOTAL		$4963

TABLE 6

PRE-RECORDED EVIDENCE: SINGLE CAMERA,

SINGLE MICROPHONE SYSTEM (PORTABLE)

Quantity	Item	Unit Cost	Total Cost
1	Sony AV3650 Video Tape Recorder	$1245	$1245
1	Sony AVC3200 DX Unit (includes tripod, viewfinder, zoom lens, microphone, and camera)	830	830
1	Odetics VTG-33 Video Timer with year, month, day, hour, second, and variable positioning.	850	850
1	Sony PVM9200 9 inch portable Monitor/ Receiver	225	225
	TOTAL		$3150

TABLE 7

SYSTEM FOR EDITING PRE-RECORDED

VIDEOTAPE PRIOR TO TRIAL

Quantity	Item	Unit Cost	Total Cost
2	Sony AV3650 Editing Video Tape Recorder	$1245	$2490
2	Sony CVM112 Monitor/Receiver	275	550
			$3040

TABLE 8

RF PLAYBACK OF PRE-RECORDED VIDEOTAPE

Quantity	Item	Unit Cost	Total Cost
1	Panasonic NV3010 EIAJ-1 Video Player	$ 595	$ 595
1	Sony CVM112 11 inch Monitor/Receiver	275	275
3	Magnavox 5916 23 inch Monitor/Receiver	335	1005
* 1	Panasonic NV-U72 RF Converter	50	50
1	Jerrald TAC-84 RF Amplifier	45	45
	TOTAL		$1970

*Note: Need channel selected for open channel in local area.

TABLE 9

COURTROOM RECORDING SYSTEM: WITHOUT SPECIAL EFFECTS

Quantity	Item	Unit Cost	Total Cost
2	Sony AV3650 Video Tape Recorder	$1245	$2490
4	GBC CTC-5000 Low Light Level Camera	495	1980
1	Pelco P-77-24 Silent Pan & Tilt Scanner	425	425
1	Pelco PT1524-M Modular/Joystick Pan & Tilt Control	125	125
* 1	Pelco TV-J8C 11.5 - 90mm F2.1 Motorized Zoom Lens	950	950
1	Odetics VTG-33 Video Timer with year, month, day; hour, second, and variable positioning	850	850
1	Pelco L25DT Motorized Zoom Lens Control Unit	125	125
* 1	Canon M-6C 16.5 - 92 F2.0 Manual Zoom Lens	550	550
* 2	Fujinon TV-CF 12.5A 12.5 F1.4 Wide Angle Lens	295	590
2	Sony VCS-31 Three Camera Switcher	50	100
1	Sony PVM-400 Monitor Assembly	750	750
1	Sony CVM 920U Portable Monitor/Receiver	225	225
* 6	Shure 579SB Microphones, Omni-directional, Low impedance with on/off switch	45	270
2	Shure M67 Microphone Mixers	270	540
6	Shure S55P Isolation Desk Stands	29	174
1	Custom Console	150	150
	TOTAL		$10,294

*Note: The number type of microphones and lenses will vary with the size and design of a courtroom. Does not include installation cost, mounting, cabling, or discount.

Table 10 describes the same configuration as Table 9, except that it includes a Special Effects Generator to allow the operator to combine camera signals through effects such as corner inserts or split screens. Table 11 describes the same configuration as Table 9, and adds a courtroom playback capability. This courtroom recording system includes components which enable simultaneous recording of proceedings while playing back pre-recorded deposition/testimony or evidence.

C. Video Equipment Purchase Prices

1. Videotape (1/2 Inch, EIAJ-1)

Listed at Tables 12, 13, and 14 are three examples of the range in volume discounts that can be obtained when purchasing videotape. The examples selected are for 1/2 inch, EIAJ-1 videotape and indicate the range of prices a legal user can expect to pay for videotape, depending on quantity and source. Table 12 reflects purchase from a commercial source; Table 13 reflects typical costs if qualified to buy as a government user; and Table 14 reflects costs if qualified to buy as an industrial consumer.

The value of identifying and obtaining currently available discounts on videotape purchases must be stressed. The often expressed advantage of turn-around for videotaped court records, allowing a re-use of tapes and lower long-run costs, requires scrutiny; there is a propensity for courts and reporters to hold onto court records for long periods of time. Thus, cost of videotapes has the potential to always be a recurring cost, directly related to volume of production. Equipment, on the other hand, is a relatively large, but one-time capital cost

TABLE 10

COURTROOM RECORDING SYSTEM: WITH SPECIAL EFFECTS

Quantity	Item	Unit Cost	Total Cost
2	Sony AV3650 Video Tape Recorder	$1245	$2490
4	GBC CTC-5000 Low Light Level Camera	495	1980
1	Pelco P-77-24 Silent Pan & Tilt Scanner	425	425
1	Pelco PT1524-M Modular/Joystick Pan & Tilt Control	125	125
1	Pelco TV-J8C 11.5 - 90mm F2.1 Motorized Zoom Lens	950	950
1	Odetics VTG-33 Video Timer with year, month, day, hour, second, with variable positioning	850	850
1	Pelco L25DT Motorized Zoom Lens Control Unit	125	125
* 1	Canon M-6C 16.5 - 95mm F2.0 Manual Zoom Lens	550	550
* 2	Fujinon TV-CF 12.5A, 12.5, F1.4 Wide Angle Lens	295	590
1	Sony SEG-11 Special Effects Generator with preview, corner insert.	800	800
1	Sony PVM-400 Monitor Assembly	750	750
1	Sony CVM-920U Portable Monitor/Receiver	225	225
* 6	Shure 579SB omni-directional low impedance Microphones with on/off switch	45	270
2	Shure M67 Microphone Mixers	270	540
6	Shure S55P Isolation Desk Stands	29	174
1	Custom Console	150	150
	TOTAL		$10,994

*Note: As in the previous system the number and type of microphones and lenses will vary with the size and design of a courtroom. Does not include installation cost, mounting, cabling, or discount.

TABLE 11

COURTROOM RECORDING SYSTEM: WITHOUT SPECIAL EFFECTS, BUT WITH PLAYBACK CAPABILITIES

Quantity	Item	Unit Cost	Total Cost
2	Sony AV3650 Video Tape Recorders	$1245	$2490
4	GBC CTC-5000 Low Light Level Cameras	495	1980
1	Pelco P-77-24 Silent Pan and Tilt Scanner	425	425
1	Pelco PT1524 Modular/Joystick Pan & Tilt Control	125	125
* 1	Pelco TV-J8C 11.5 - 90mm F2.1 Motorized Zoom Lens	950	950
1	Odetics VTG-33 Video Timer with year, month, day, hour, second, with variable positioning	850	850
1	Pelco L25DT Motorized Zoom Lens Control Unit	125	125
1	Canon M-6C 16.5 - 92 F2.0 Manual Zoom Lens	550	550
* 2	Fujinon TV-CF 12.5A 12.5 F1.4 Wide Angle Lens	295	590
2	Sony VCS-31 Three Camera Switcher	50	100
1	Sony PVM400 Monitor Assembly	750	750
1	Sony CVM920U Portable Monitor/Receiver	225	225
* 6	Shure 579SB Omni-directional, Low impedance with on/off switch	45	270
2	Shure M67 Microphone Mixers	270	540
1	Jerrold RF Amplifier	45	45
2	Magnavox 5916 23 inch Monitor/Receiver	335	670
1	Sony CVM112 11 inch Monitor/Receiver	275	275
1	Custom Console	150	150
** 2	Sony RFU-52W RF Adapters	60	120
	TOTAL		$11,404

*As in previous system the number and type of microphones and lenses will vary with the size and design of a courtroom. Does not include installation costs, mounting, cabling or discount.

**Need channel selected for open channel in local area.

TABLE 12

COMMERCIAL DISCOUNTS AVAILABLE

FOR 1/2 INCH, EIAJ-1 VIDEOTAPE

Playing Time (Min.)	Reel Diameter	Quantity in Reels 1 - 5	6 - 11	12 - 23	24+
a) Videotape:					
60	7"	$34.00	$30.00	$27.00	$25.00
30	7"	18.00	16.50	15.50	14.50
30	5-1/8"	18.00	16.50	15.50	14.50
20	4-5/8"	15.00	14.00	13.00	12.00
10	4-5/8"	10.00	9.50	8.50	8.00
b) Empty Reels:					
60	7"	$ 3.00	$ 2.50	$ 2.50	$ 2.50
30	7"	3.00	2.50	2.50	2.50
30	5-1/8"	3.00	2.50	2.50	2.50
20/10	4-5/8"	2.75	2.25	2.25	2.25

TABLE 13

*GOVERNMENT CONTRACT PRICE

FOR 1/2 INCH, EIAJ-1 VIDEOTAPE

Playing Time (Min.)	Reel Diameter	Per Reel, Any Quantity
60	7"	$18.38
45	7"	16.62
30	5-1/8"	10.10
30	4-5/8"	10.56
20	4-5/8"	6.88
10	4 5/8"	6.09

* Extracted from State of Georgia Contract No. 6-42700-A

TABLE 14

*INDUSTRIAL CONSUMER NET PRICE

FOR 1/2 INCH, EIAJ-1 VIDEOTAPE

Playing Time (Min.)	Reel Diameter	Quantity in Reels 1-19	20-99	100-199	200-299	300-349	500+
60	7"	$35.00	$34.13	$33.25	$32.38	$31.50	$30.63
50	7"	32.50	31.69	30.88	30.06	29.25	28.44
40	7"	29.00	28.28	27.55	26.83	26.10	25.38
30	7"	25.00	24.38	23.75	23.13	22.50	21.88
20	4-5/8"	20.00	19.50	19.00	18.50	18.00	17.50
10	4-5/8"	17.00	16.58	16.15	15.73	15.30	14.88

* Extracted from 3M, M-V-26 Price Sheet of May 1, 1973

which can be amortized. If video recording is to be used extensively, videotape cost presents an area for effecting immediate and quite possible continuing cost savings. Although a definitive, comparative cost-effectiveness analysis of video recording in the legal environment is yet to be done, it is clear that the cost of the recording medium (the videotape, in the case of video recording) will significantly impact the analysis. In this regard, it is suggested that a proper and fair cost-effectiveness comparison between alternative recording mediums will not be possible without considering the effect available discounts have on medium cost (this holds true for any medium).

2. Video System Components

Table 15 contains a selected listing of purchase prices for currently available, off-the-shelf video system equipment. Equipment manufacturers have been arrayed alphabetically, with equipment selected from product lines listed. Components selected for inclusion are those from each vendor line deemed to possess features of value for court related video recording.

The list at Table 15 is based upon subjective review of available equipment information; its value is in giving the potential legal user a quick summary of equipment costs for that group of equipment from which he would likely choose a video recording system. The range of equipment listed covers basic and inexpensive components as well as relatively sophisticated and costly components. This approach allows a potential user to get an idea of what is available, and select a video configuration according to his needs and budget.

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Akai Camera, Ltd. 2139 E. Del Amo Blvd. Compton, California 90220	VTS - 110DX 1/4" Portable Video Tape Recorder Set with VTR, Camera with built-in Microphone, Portable Monitor, AC Adapter, 6 to 1 Zoom Lens	$ 1695
	VTS - 100S, 1/4" Portable VTR Set, VTR without Sound dub, 4 to 1 Zoom Lens	1395
	VTS - 700 1/4" VTR, 10 1/2" reel, 80 minute record capability	995
	VC-115 Camera	745
	CCS-1505 Color Camera, 6 to 1 Zoom Lens	3395
	20 minute 1/4" Video Tape	10
	80 minute 1/4" Video Tape	15
Ampex Corporation 401 Broadway Redwood City, California 94063 Firm withdrew from field effective August, 1972.	VR-420 - 1/2" EIAJ-1 Color VTR	1250
	VPR-5200 - 1" Black and White VTR with edit	2500
	VPR-5800C - 1" Color or Black and White VTR	6250
	VPR-4500 - 1" Color Player Black and White	2150 1650
	CC-400 - Multipurpose Camera	400
	CC-452-01 - Viewfinder Camera	995
	AC-125 - Television Production Center - 3 camera - Special Effects Generator and Mixer	2950
	TR-823 - 23" Black and White Monitor	320
	163-30 - 1/2" Video Tape - 1250 feet	22
	163-60 - 1/2" Video Tape - 2400 feet	40
Berkely - Colortran, Inc. 1015 Chestnut Street Burbank, California 91502	Mini-Pro Lighting Kit	350

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Concord Communication Systems 40 Smith Street Farmingdale, New York 11735	VTR-800 - 1/2" EIAJ-1 VTR	$ 850
	VTR-1120 - 1/2" EIAJ-1 Electronic Edit VTR - Color Capability	1650
	VTR-650 - 1/2"-EIAJ-1 Solenoid VTR	1300
	VTR-460E - 1/2" EIAJ-1 Portable VTR and Camera Ensemble	1750
	VUR-7500 - 3/4" Video Cassette Player/Recorder with color capability	1500
	CTC-30 - Industrial Television Camera	255
	CTC-33 - Low light level Camera	450
	TCM-30 - Viewfinder Television Camera	550
	PTC-15-AC Portable Television Control Console with con lock	2495
	VM-201 - 5/1/2 Video Monitor	200
	VM-601 - Three Screen 5 1/2" Monitors	625
	MR-750 - 9" Video Monitor/Receiver	200
	MR-900 - 1[illegible] Monitor/Receiver	300
	MRC-12 - 12" Color Monitor/Receiver	550
	VC-60 - 60 minute Video Cassette	35 26/100
	VT-1B 1/2" 2400 feet Video Tape - 1 hour	35 26/100
Electrovoice, Inc. 603 Cecil Street Buchanan, Michigan 49107	635A - Omnidirectional, low impedance microphone, balanced line	57
	1751 - Condenser cardioid microphone, low impedance balanced line	75

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
GBC Closed Circuit TV Corp. 74 5th Avenue New York, New York	CTC-5000 - Camera	$ 495
	CTC-4000 - Camera	253
	CTC-5002 - Camera, High Resolution 10.000 to 1 ALC	525
	CTC-2001 - Two-piece CCTV Camera	523
	CTC-8000 - Ultra High Resolution Camera	3475
	TD-1400B - Total darkness CCTV Camera	995
	ST-705 - Westinghouse Image Intensifier Camera	9390
	ST-705R - Westinghouse Camera for outdoor use	11245
	VF-302 - Viewfinder Camera with 5" Monitor	795
	MV-SAYRM - Triple 5" Monitor	1100
	MV-5 - 5" Solid State Video Monitor	325
	MV-900 - 9" Monitor	179
	MV-17 - 17" High Resolution Monitor	369
	MV-20 - 20" High Resolution Monitor	395
	ERZL-1 - Remote Control Zoom Lens, 15 to 150mm f2.5	1095
	ERZL-2066 - 22 to 66mm f1.8 Motor Zoom Lens	619
	15 to 145mm F2.5 Motor Zoom Lens	895
	GBCMTA 5100 - Special Effects Generator	695
	MEA-1002 - Special Effects Generator with preview	2395
	MEA-5100 - Special Effects Generator	695
	SG-210 - Full EIA Sync Generator	595
	GBCTG 3201 - Time&Date Generator	1100
	US-S - Video Switcher	60
	7262A Hitachi Tube Replacement 2/3 Vidicon for Sony and Panasonic Cameras	69
	7038 1" Vidicon Grade A Tube Replacement	69
	8823 2/3 Separate mesh Vidicon tube for Sony portable camera	69
	2/3" Silicon Diode Array	750
	1" - Silicon Diode Array	500
	LK-3 Quartz Studio lighting kit	139
	T-3 Heavy duty tripod	239
	T-10 - Dolly	39
	VD-101 - Video Distribution Amp	156
	EA-102 - Booster Amplifier	168
	CTC-3XV - 3 Vidicon Color Cameras	9950

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Impossible Electronic Techniques Box 467 121 Coulter Avenue Ardmore, Pennsylvania 19003	LL-15 - Low Light level Camera with infra red capability	$1995
	LL-500 - Low light level Camera	1200
	VTG-32B - Time Date Generator	900
	Low light Level Vidicon Tube for porta-pack	1250
	Automatic Iris Control for Canon Zoom Lens	325
International Video Corporation 980 Almanor Avenue Sunnyvale, California 94086	IVC-870 - 1" Monochrome Recorder/Reproducer with insert and assemble electronic edit - 1"	7500
	IVC-825A - 1" Monochrome Recorder/Reproducer with instant video confidence	5700
	VCR-100 - 1" Cartridge Monochrome Recorder/Reproducer	2300
JVC Industry, Inc. 58-75 Queens Expy Maspeth, New York	KV-350 - 1/2" EIAJ-1 VTR	725
	KV-360 - 1/2" EIAJ-1 Black and White Editing VTR	1135
	PV-3500 - 1/2" EIAJ-1 Color or Black and White VTR	1250
	PV-1300 - Color Player	875
	CR-6000- 3/4" Video Cassette Recorder (color capability)	1645
	GS-4500/PV-4500 1/2" EIAJ-1 Portable Video Recording System	1725
	GS-1500 - Camera	310
	GS-2300 - Viewfinder Camera	595
	KC-1003 - 3 Vidicon Color Cameras	8300
	TK-122 - 1" Vidicon Camera	400
	TKE-1 - Video Switcher	80
	TKE-2 - Superimposer	450
	TKS-3 - Sync Generator	225
	TKC-300 - Video Mixer	300
Javelin Electronics Co. 5556 W. Washington Blvd. Los Angeles, California	X400 - 1/2" EIAJ-1 VTR, 1 hour to 7 hour recording time with editing capability, uses 4 video heads on slow speed	1995
	VC110 - Camera	350
	3VHI - Viewfinder/Monitor - 3"	225

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Karex, Incorporated 1262 Lawrence Station Rd. Sunnyvale, California 94086	SC-2 - 7: Reel 1/2" Video Tape - 250 feet	$ 22
	SC-3 - 7" Reel 1/2" Video Tape - 2400 feet	40
	SC-6 - 9 3/4" Reel 1" Video Tape - 1500 feet	45
	SC-7 - 9/3/4" Reel 1" Video Tape - 3000 feet	60
	SC-9 - 8" Metal Reel 1" Video Tape - 2460 feet	60
Magnavox Company Fort Wayne, Indiana 46804	CU-2000- Color Camera	4500
	CU-3000- Color Camera	4100
	CU-4000- Color Camera	2300
	C5950 - 25" Color Monitor/Receiver	490
	T980 - 23" Color Monitor/Receiver	550
	T5916 - 23" Monitor/Receiver	260

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Panasonic Matsushita Electric Corporation of America 200 Park Avenue New York, New York	NV-3020 1/2" EIAJ-1 VTR	$ 850
	NV-3040 1/2" EIAJ-1 VTR with solenoid operation and remote control	1325
	NV-3020SD - VTR with Edit	1150
	NV-3130 1/2" EIAJ VTR Color or Black and White with insert and assemble edit	1650
	NV-2120 - 3/4" Video Cassette Recorder/Player with color or black and white	1450
	NV-505 - 1" Color adaptable VTR with edit capability	5000
	NV-5120 - 1/2" EIAJ-1 Video cartridge Recorder/Player color or black and white	1350
	NV-3120 - 1/2" EIAJ-1 VTR	1250
	NV-3150 - VTR, color or black and white solenoid, editing, insert and assemble with two audio channels, audio and video meters *Not available at this date	N/A
	NV-3010 - 1/2" EIAJ-1 Video Player	595
	NV-510 - 3 input Video Switcher	37
	NV-P-26 - 60 minute Video Cassette Tape	35
	NV-U74-90 - RF Converter	50
	WV-240P - Vidicon Camera	375
	WV-341P - Vidicon Camera with built in monitor	595
	WV-250P - Vidicon Camera with low light level. 5 footcandle	475
	WV-341EN - Vidicon Camera Kit with Microphone & Zoom Lens	795
	WV-2000P - Deluxe Color Camera	9000
	TN-93 - 8" High resolution CCTV Monitor	250
	TN-932 - Twin 8" High Resolution CCTV Monitor	500
	TR-910V - 8" Monitor/Receiver	190
	TR-513V - 13" Monitor/Receiver	240
	TR-195V - 22" Monitor/Receiver	375
	TR-220U - 12" Color Monitor/Receiver	550
	TR-220U - 18" Color Monitor/Receiver	650
	TR-910M - 8" CCTV Monitor	300
	WJ-120P - Sync Pulse Generator - 3 output	250
	WJ-140P - Pulse Distribution Amp - 6 output	150
	WJ-540P - Special Effects Generator	800
	YV-922 - Special Effects Generator with composit video input	950
	UP-100 Heavy Duty Tripod	200

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Pelco Sales, Inc. 351 E. Alondra Blvd. Gardena, California 90248	PT-77 - Silent Pan and Tilt Unit	$ 425
	PT-24-S - Indoor Pan and Tilt Unit	325
	ZCPT-22C - Pan and Tilt Zoom Control Module	240
	TV10C-2 - Power Zoom Lens, 15mm to 150mm, F2.0	2250
	TV-J8C - 11.5mm to 90mm Power Zoom Lens F2.1	950
	TV-J4C - 12.5mm to 50mm F1.8 Motor Zoom Lens	620
SC Electronics 530 5th Avenue, N.W. St. Paul, Minnesota 55112	5M916RM3 - Triple 5" Black and White Monitors	695
	6M917 6" Black and White Monitor	219
	3M912S 23" Black and White Monitor	315
	3ER2100-11 - 23" Black and White Monitor	319
	3ER2100 - 23" Black and White Monitor/Receiver	364
	SEC904 -B0F - 25" Color Monitor/Receiver	749
Sanyo Electric, Inc. 1200 W. Walnut Street Compton, California 90220	VTR-1200 - 1/2" EIAJ-1 VTR	2395
	VTC-710Portable Video Cassette Recorder Camera System 4 3/4 IPS	N/A
	VC-115- - Low Light Level Camera	400
	VCM 200 - Low Light Level Camera with Viewfinder	575
	VC-1120 - Low Light Level Camera	300
	VCS-3000 - Low Light Level Camera with Silicon Tube	1650
	VM-4090 - 9" Black and White Monitor	150
	VM-4120 - 12" Black and White Monitor	275
	VM-4150 - 15" Black and White Monitor	325

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Shibaden Corporation of America 58-25 Brooklyn Queens Expy Woodside, New York 11377	SU-510Du 1/2" EIAJ-1 Black and White VTR with editing capability	$1150
	SV-520DU 1/2" EIAJ-1 Color Record/Playback VTR with Electronic Editing	1650
	SV-510U 1/2" EIAJ-1 Black and White VTR	775
	SV-520U 1/2" EIAJ-1 Color or Black and White VTR	1250
	SV-700UC 1/2" EIAJ-1 Black and White VTR with AGC	995
	SV-FP707U 1/2" EIAJ-1 Portable VTR and Camera Kit	995
	FP-1200 Color Camera, 3 - 1" Plubicon Tubes	16260
	TU-120U 12" Monitor/Receiver	229
	TU-190UL 19" Monitor/Receiver	270
	TU-230UL 23" Monitor/Receiver	335
	VM-502 5" Monitor	200
	3VM-502, 3RM 5" Triple Monitors	625
	56 - 104 Sync Generator	552
	56-105L Sync Generator with 2 to 1 Interlace	N/A
	VL-U35 VHF Converter	40
	TM-15U VHF Converter	40
	HV-405 2/3" Vidicon Camera	300
	HV-50 1" Vidicon Camera with Random Interlace	395
	HV-505 Vidicon Camera with 2 to 1 Interlace	395
	HV-70F Camera with Detachable Viewfinder and Lens	595
	FPC-1000A 3-2/3 Vidicon Color Camera	9950
	FPC-1000H 3-2/3" Vidicon Color Camera	13950
	VMF-106 Switcher Fader	290
	SE-101S Special Effects Generator	350
	SE-103 Special Effects Generator	845
	EA-101 Color Special Effects Generator	590
	EA-103 Color Effects Amplifier	
	CS-104 Camera Switcher (4 position)	44
Shure Brothers, Inc. 222 Hartley Avenue Evanston, Illinois 60204	533SB - Omnidirectional, low impedance microphone with balanced line and on/off switch	34
	579SB - Omnidirectional, low impedance microphone with balanced line and on/off switch	45
	SM60 - Omnidirectional, low impedance microphone with balanced line and on/off switch	49
	M67 - Microphone mixer with VU Meter	270
	M68 - Microphone Mixer	84
	A95P - Impedance Matching Transformer	14

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SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Sony Corporation of America 47-47 Van Dam Street Long Island City New York City, New York 11101	AV-3650 - 1/2" EIAJ-1 VTR	$1245
	AV-3600 1/2" EIAJ-1 VTR	860
	AV-3400AUC-3400 1/2" EIAJ-1 Video Rover II System Portable	1745
	AV-8600 1/2" EIAJ-1 Color or Black and White VTR	1150
	VO-1600 - 3/4" Video Cassette Recorder/Player - color or black and white	1395
	AVC-3200 - Camera	425
	AVC-3200DX - Camera Kit with Viewfinder, Microphone and Zoom Lens	830
	VCS-31 - Camera Selector - 3 Cameras	55
	CVM-920U 3" Portable Monitor/Receiver	250
	CVM-112 - 11" Portable Monitor/Receiver	275
	CVM-192U 18" Portable Monitor/Receiver	335
	PVM-400 - 4" Quadruple Rack Monitor	750
	PVM-900 - 9" Double Rack Monitor	450
	CKV-121 - 12" Color Monitor/Receiver	400
	CKV-171 - 17" Color Monitor/Receiver	500
	VCL-1206 - F 1.8, 12.5 to 75mm Zoom Lens	245
	VCL-08 - F.15 to 8.5mm Wide Angle Lens	81
	MX-900 - Microphone Mixer	270
	AVF-3200 - Electronic Viewfinder	215
	RFC-52W - 57W - R.F. Adapters	59
	V-32 - 60 Minute Video Tape	40
	V-30H - 30 Minute Video Tape	20
	V-31H - 30 Minute Video Tape	40
	KC-60 - 60 Minute Video Tape Cassette	35
	EV-320F - 1" Black and White Video Recorder with edit	5900
	CLP-1B - Color Adapter for EV-320Y	1000
	HCT-20A Tripod	49
	TD-1 - Dolly	55
	SEG1 - Special Effects Generator	595
	SEG2 - Special Effects Generator with 6 input and preview	900

(Continued)

SELECTED LISTING OF CURRENTLY AVAILABLE OFF-THE-SHELF VIDEO SYSTEM EQUIPMENT

Company and Address	Equipment	Purchase Price
Telemation, Incorporated P.O. Box 15068 Salt Lake City, Utah 84115	TCM-1100 - General Purpose Low Light Level Camera, with Vidicon Tube	$ 700
	with Silicon Tube	1200
	TPA-551 - Pulse Distribution Amplifier	225
Turner - Division of Conrac Corporation 909 17th Street, N.E. Cedar Rapids, Iowa 52402	35A - Omnidirectional Lavalier Microphone, low impedence, balanced line	48
	2300 - Omnidirectional Low impedance Microphone, balanced line	48
Vicon Industries, Inc. 130 Central Avenue Farmingdale, New York	12.5 to 100mm F2.0 Zoom Lens	967
	V1435, 144S, 145S, V146S Video Switcher	15
	V-300 PT - Pan and Tilt Drive Unit	518
	V20 - 100mm F1.8 Power Zoom Lens	770
	V-111PT Pan and Tilt Control Unit (joystick)	123
	V-366 Apt - Studio Silent Indoor Pan and Tilt	470
	V8 - 1.4 to 8mm, 1.4 Wide Angle Lens	99
	V12.5 to 75mm F1.8 Manual Zoom Lens	350
	V11-90mm F2.0 Manual Zoom Lens	395
	V118 APT Push Button Control for V-366 APT Silent Pan and Tilt Unit	80
	V-100C Zoom Lens, Remote Control Unit	125

IV. DESCRIPTION OF VIDEO SYSTEM EQUIPMENT

A. Equipment Characteristics

A video tape system is made up of a series of components, and basically consists of one or more cameras, microphones, video tape recorders, and monitors. The purpose of a video tape system is to accurately and reliably capture a scene, transfer it into an electrical signal, store that signal on magnetic tape, and later transform the stored signal back into a reproduction of the original scene.

1. Video Cameras and Accessories

The video camera is the component which transfers the visual scene to an electrical signal. The portion of the camera which regulates this process is the video image tube; the type utilized constitutes the primary difference between cameras, aside from whether the camera is capable of color processing or just black and white (Figure 2).

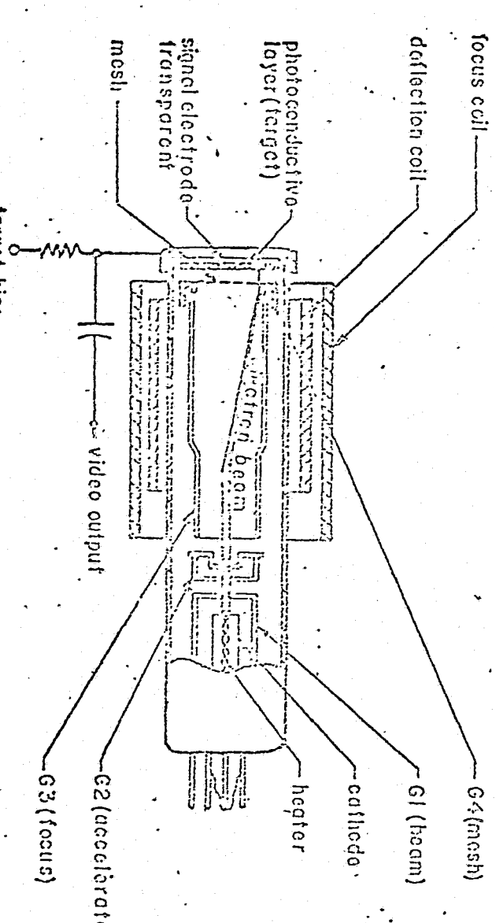

Figure 2. Vidicon Image Tube

Most color video cameras use three image tubes, one for each primary color (red, blue, green). An important difference between color and black and white image tubes is that color image tubes require more lighting to generate a satisfactory picture. Most color cameras require at least 150 footcandles of light in which to operate satisfactorily, as compared to 20 footcandles for black and white; they also require a special type light for accurate color reproduction because normal incandescent lighting generates an overabundance of red in relation to other primary colors.

All black and white video cameras use one video image tube, although it may be of several different types. The most basic and inexpensive type is the Vidicon tube; for most applications, users will find that this will adequately meet thier needs, but special lighting conditions may dictate use of another available type differentiated by size (2/3 inch or 1 inch) and nature of the target surface used (separate mesh or regular). The 2/3 inch Vidicon tube allows the camera to be smaller; a separate mesh Vidicon tube is a more accurate reproducer of scene detail than a regular Vidicon tube. Good Vidicon tube operation is achieved in normal lighting conditions (30 footcandles); these tubes "burn" when exposed to bright light. Burning will cause a permanent image to be left on the tube and, consequently, on each new scene. Cameras which employ Vidicon tubes will not generate good contrast in low-light level conditions.

Some black and white cameras have Silicon Diode tubes. The Silicon Diode tube is more sensitive to light and will generate better contrast than a Vidicon tube when used in low-light levels. Although the Silicon

tube will not burn like the Vidicon, the sensitivity of the Silicon tube often over-reacts to a bright spot in a scene, causing a "blooming" effect. Unfortunately, the Silicon tube will not accept the automatic gain control circuitry used by Vidicon cameras to circumvent this problem. However, an automatic iris control (Impossible Electronics, $325) is available to help alleviate this problem. A camera equipped with a Silicon image tube will cost approximately 50%-60% more than a Vidicon camera. A Silicon tube can be placed in a Vidicon equipped camera, but the automatic gain control circuitry must be disabled. Some manufacturers make cameras which can easily be changed from Vidicon to Silicon (example: Telemation TMl100 camera with Vidicon tube lists for $700 while the Telemation TMl100 with Silicon tube lists for $1,100). Plumbicon tubes, a third type of image tube, is also useful for low-light level conditions. Plumbicon tubes will last longer and will not burn as easily as Vidicon tubes, but they cost approximately five times as much as Vidicon tubes.

Some cameras include an internal synchronization (sync) source; these usually have a switch that disables this source when an external source of sync is used, such as a Video Tape Recorder, a Special Effects Generator, or a Sync Generator. Other cameras have plug-in sync circuit boards (example: GBC CTC5000); some of these sync sources are capable of driving more than one camera (example: GE TE3 3D), a feature which could eliminate some wiring in a multicamera system. Cameras including an internal sync signal will cost approximately $90-$125 more. Internal sync is useful in a one camera system when no external sync source is present; however, multicamera systems require a common sync source

to all cameras to minimize roll, regardless of whether the source is internal or external.

Many cameras come with or have the capability to add a viewfinder, allowing the operator to see what is being picked up (examples: Panasonic WV361P, Sony AVC3200, Sony AVF3200). Several cameras also add such special features as a tally light which comes on when the camera is operating (example: Panasonic WV361P) or an intercom input to allow two-way communication between camera and director (example: Panasonic WV361P).

Cameras are designed to be either hand-held (portable units) or mounted. When mounted from a wall or the ceiling their position is fixed, whereas mounting on a tripod allows position adjustment. If tripods are used, care should be taken to match the tripod size and strength to the job; there is wide variability in ability to extend the camera height and support weight. Versatility is added to a camera by the addition of a remote control pan and tilt (P&T) device which allows an operator to control camera movement from a distance. Remote control P&T units consist of the pan and tilt drive unit, the pan and tilt unit, and cabling between the two. Pan and tilt drive units are available in regular (generates motor noise) and silent operation units; the control unit is available with either push-button or "joystick" (one lever for all directions) controls.

2. Lenses

Every video camera requires a lens; this lens is described in terms of its speed (f stop) and focal length. The speed of a lens (f stop), variable on most lenses, determines the maximum amount of

light allowed through the lens. An f1.5 lens will allow more light through to the image tube than an f2.5 lens for the same scene brightness (Figure 3). The focal length of a lens determines the scene area picked up by the camera; lenses are either fixed focal length (single setting) or variable focal length (many settings, called a zoom), with focal length being measured in millimeters. When selecting lenses, remember that the larger the number of millimeters, the smaller the area picked up by the camera. Focal lengths are also described in terms of width of field. A "wide" angle focal length lens, such as a 12.5mm lens, allows more viewing area to be picked up by the camera, and shows subjects in the scene as being much smaller than "narrow" angle lenses (Figure 4). Lens prices vary in relation to focal length, ability to change focal length, and speed. Lenses are made for each sized camera image tube (2/3 inch and 1 inch), but are not interchangeable between these sizes.

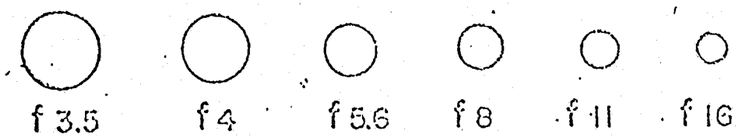

Figure 3
Typical Range of f Stops

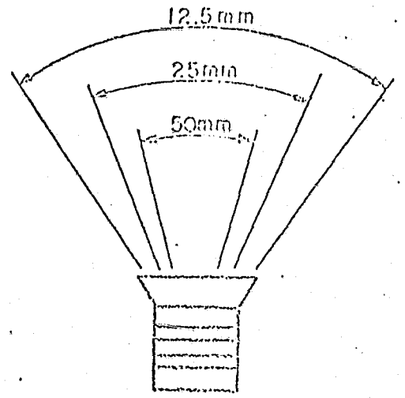

Figure 4 Angle of View
Compared To Lens Focal Length

The zoom feature increases lens cost, but also adds versatility to a a camera because it allows the operator to vary focal length over a range (example: Vicon 12.5mm-75mm f1.8 Manual Zoom Lens). Zoom lenses are controlled either manually or remotely by electronic means. A complete remote controlled power zoom lens unit consists of the variable lens itself plus a separate control unit and cabling between the two. Most power zoom control units include controls for focal length, focus, and speed.

3. Monitors and Receiver/Monitors

A monitor or receiver/monitor is the video tape system display unit which transforms a picture signal into a reproduction of the original scene. Video system monitors and receiver/monitors allow

an operator to see what the camera sees and allow other viewers to see what has been video tape recorded. Both monitors and receiver/monitors are designed to accomplish the same basic display function; the difference is that a monitor must have its signal delivered by coaxial cables (one for video, one for audio, if monitor has audio), while a receiver has its signal delivered by radio frequency (RF) through a single cable connection (both video and audio to an antenna. A receiver/monitor has the capability of having its signal delivered either way. Most monitors are designed for only video reproduction, while receiver/monitors are designed for video and audio reproduction. Cost will vary according to size and quality of the display unit but generally, a receiver/monitor will cost approximately $75 more than a standard monitor of the same size. A receiver/monitor with color capability will cost approximately $200 more than a black and white receiver/monitor of the same size.

4. Video Tape Recorders

The Video Tape Recorder (VTR) takes the electrical signals fed by video camera and audio components of the video tape system and stores them on magnetic tape or sends signals obtained from a tape back through the system's display units (playback). The different types of VTRs can be identified primarily by video tape format and width; types available off-the-shelf are: 2 inch, 1 inch, 3/4 inch cassette, 1/2 inch cartridge, 1/2 inch EIAJ-1 reel to reel, 1/2 inch EIAJ-1 portable, and 1/4 inch reel to reel.

a) The 2 inch VTR, either helical scan or quadruplex, is the most expensive and most accurate video tape recorder. Used primarily for broadcast quality recording, these VTRs record at one of the following

speeds: either 7.5 or 15 inches per second; most generally at 15 inches per second. Video recording on the 2-inch VTR is very expensive; tape cost is increased substantially by tape size and volume required. The 2 inch VTR is considered inappropiate for widespread use by the legal community, and will not be discussed further.

b) The 1 inch VTR uses the helical scan technique of recording, and can record with broadcast quality in black and white. A color 1 inch machine will cost only a few hundred dollars more than its black and white counterpart. The extra features of assemble editing, capstan servo control (servo control is a must if clean edits are to be obtained) add approximately $1,200 to the price of a 1 inch VTR; an insert editing VTR costs approximately $3,000 more than an assemble editing VTR. Most 1 inch VTRs have edit capability, two channel audio capability and accept low impedance balanced line input. Almost all 1 inch VTRs are designed with signal strength meters for both video and audio inputs. This allows the operator to make sure that both video and audio signal levels are the proper strength to facilitate good recording. At least one 1 inch VTR has an "instant video confidence" feature. This is a monitoring system which plays back the tape while it is being recorded, insuring the operator that he is recording properly. Transport functions, such as forward, record, rewind, and fast forward are usually solenoid; mode selection is by electronic pushbutton, which provides ease of operation and facilitates remote control.

Recordings made on one brand of 1 inch VTR may not produce the same quality picture when played back on another brand because there

are no accepted industry format standards for this size VTR. Tape speed also varies from manufacturer to manufacturer, and different brand VTRs use different sized video tape reels; this drastically limits interchangeability. for example; even if format and tape speed are the same, at 7.5 inches per second (ips), if one machine uses a 9 3/4 inch reel while another uses an 8 inch reel, interchangeability is limited; interchangeability can only be upward in reel size, not downward. Video tape for 1 inch machines costs approximately $60 per hour (small quantities).

c) A 3/4 inch cassette VTR format standard was introduced by several manufacturers in 1972; this format uses helical scan recording and playback as do 1 inch and 1/2 inch VTRs. The video cassette differs from a reel to reel medium in that the magnetic tape is permanently housed in a plastic container (8 3/4 x 5 1/2 x 1 inch), called a cassette. The video tape recorder is self-threading; the tape is automatically removed from the cassette and is threaded over the erase head and around the video head. Tape return is through a reverse of the threading process. The threading process takes approximately 6 seconds. The 3/4 inch cassette records and plays at 3 3/4 inches per second. A small plastic plug may be removed from the rear of the cassette after recording, to prevent accidental erasure of recorded material. These video cassettes are interchangeable among five manufacturers, and are available in different recording lengths, up to a maximum of about one hour. Typical cost for one hour cassettes is $35 (quantities of 12).

One feature incorporated into all 3/4 inch video cassette VTRs is color recording capability. Audio inputs on most video cassettes are high impedance unbalanced, with capability to record onto two separate audio tracks. Automatic gain control circuitry, without manual override, is found on most video tape recorders using this format. Editing capability is currently available on only one 3/4 inch video cassette recorder (JVC CR6000U); this machine accomplishes its edits without the benefit of a capstan servo control device. Another machine (Sony VO1600) can be modified to permit editing, through use of a non-standard accessory device which also allows remote control of transport functions (Avonix, $295).

d) A new 1/2 inch cartridge VTR format has recently been developed which conforms to the EIAJ-1 standard for 1/2 inch VTRs. The cartridge differs from a cassette in that the cartridge houses only a feed reel while the cassette is stored on two reels, one feed reel and one takeup reel. In the 1/2 inch cartridge VTR, the takeup reel is included in the machine itself. Like the cassette machine, the cartridge machine automatically threads the tape after the cartridge has been inserted. Stop, play, rewind, record and fast forward functions are selected by push buttons. When the tape ends, it is automatically rewound and the cartridge pops out.

Most 1/2 inch cartridge VTRs have color as well as black and white recording capability. Cartridge players as well as recorder/players are available, but maximum recording or playing time for cartridge systems is 30 minutes. A 1200 foot, 30 minute cartridge costs approximately

$22. The 30 minute recording capability requires a special tape, thinner than that used in 1/2 inch EIAJ-1 reel to reel VTRs. Regular thickness 1/2 inch tape is available in 20 minute and 10 minute lengths. A tape which has been recorded on an EIAJ-1 1/2 inch reel to reel recorder may be enclosed in a series of cartridges for use with this machine.

e) The 1/2 inch reel to reel VTR has an industrywide standard for 1/2 inch video recording, called the EIAJ-1 standard; this standard facilitates interchangeability between manufacturers. The different manufacturers of EIAJ-1 standard 1/2 inch VTRs produce basically the same VTR, each adding their own special features. Color recording capability costs approximately $200 more than a comparable black and white recorder. All 1/2 inch reel to reel EIAJ-1 VTRs use a maximum tape reel size of 7 inches and record/play at 7 1/2 ips, although many also have a slow motion playback feature. Video tape in this size is available in lengths of 60, 30, 20, and 10 minutes; average list cost for a 60 minute reel of tape is $30-$40 (small quantities).

Automatic Gain Control (AGC) is a feature incorporated on all of these VTRs; however, only a few have manual override capability for video and audio. Manual video gain control is useful in a high contrast situation to add detail to the subject; the trade-off is a sacrifice of detail in brighter areas which are not of interest. Manual audio gain control is useful in noisy recording environments to de-emphasize noise; the AGC will amplify and thus accentuate noise during moments of conversational silence. Also, during duplication of pre-recorded tapes, manual audio gain control eliminates the compounding of noise found on the original tape.

Few 1/2 inch reel to reel VTRs incorporate separate visual meters to indicate the strength of video and audio input signals; most VTRs that do have meters have only audio signal strength meters or, at best, a switchable meter for both signals. Also, audio impedances and levels differ from manufacturer to manufacturer even though all manufacturers use unbalanced audio inputs and outputs. As an example, Sony 1/2 inch reel to reel EIAJ-1 VTRs have 600 ohm microphone input impedance, and high level, high impedance auxiliary input, with high level, high impedance audio output. This compares to Panasonic 1/2 inch reel to reel EIAJ-1 VTRs, which have 20,000 ohm microphone input impedance, with 600 ohm audio output impedance.

All EIAJ-1 1/2 inch reel to reel VTRs incorporate rewind, record, play, pause and fast forward functions, but some do use either solenoids or electrically controlled pushbuttons to select the operating mode. Solenoid operated machines cost approximately $200 more than manually controlled machines (solenoid VTRs also have footswitch selectors available if remote control is desired). "Clean" assemble editing can be accomplished on 1/2 inch reel to reel VTRs if they include a servo controlled motor to run the capstan and record heads. Assemble edit capability adds approximately $300 to the purchase price of a 1/2 inch VTR. All 1/2 inch reel to reel VTRs use a numerical indexing system, although the indexing system differs from manufacturer to manufacturer. To illustrate, an event logged at index number 900 when recording on a Sony VTR may appear at index number 915 on playback with a Concord VTR. A few manufacturers produce 1/2 inch reel to reel EIAJ-1 VTRs with time lapse recording capability. One machine

allows a 1, 6, 12, 24, or 48 hour recording time period on a single 2400 foot (one hour, at 7 1/2 ips) magnetic tape. Others (Javelin X400 and Sanyo VTR1200) allow recording at either the regular speed (1 hour) or a slow speed (7 hours).

f) A 1/2 inch portable VTR is produced by several manufacturers to conform to the EIAJ-1 standard. These VTRs accept a 5 inch reel of video tape, and have a maximum recording time of 30 minutes. An external microphone input is incorporated in the VTR. The portable units are battery operated, but can be readily adapted to 110 volt AC power. Portable units are usually sold in an ensemble consisting of: VTR, camera with built-in microphone, battery pack, carrying case, and combination 110 volt adapter/battery charger. Typically, the camera has a built-in monitor/viewfinder, which can be used for record and playback. This machine is usually carried on the shoulder or back (back-pack fashion). The camera is designed to be hand-held or used with a tripod or monopod. A shoulder harness is available, which carries the recorder and has a pan and tilt mount for the camera.

A tape produced on a EIAJ-1 1/2 inch portable system may be played back on any 1/2 inch reel to reel EIAJ-1 VTR. The battery pack supplied with the system has a short life, usually about 40 minutes; recharge time is approximately 6 hours. Longer life battery packs are available as an accessory (Sony BP-30, 3 hours of power; 16 hour charge time).

g) A 1/4 inch reel to reel VTR is produced by one company (Akai of America Ltd.). It is available as a regular, non-portable VTR and as a portable system. The non-portable version uses a 10 1/2 inch metal reel of 1/4 inch video tape, and allows a maximum recording time of 80 minutes. An 80 minute reel of 1/4 inch video tape costs $44.50; a 20 minute reel costs $9.50.

The portable version of the 1/4 inch VTR includes: battery powered VTR, camera with built-in microphone, portable monitor, and AC adapter. The portable VTR uses a 5 inch reel of tape (110 feet), and has a maximum recording time of 20 minutes.

5. Special Purpose Video Components

a) A synchronization generator is needed in every video system, whether it originates from the camera itself, the VTR, a special effects generator, a video switcher, or a synchronization (sync) generator which is a completely separate component in the system. The sync signal is the control signal in a video system. For multicamera operations, all cameras must be controlled through a common sync source in order to prevent loss of stability (rolling) when switching between cameras. The sync signal also effects picture sharpness by the type of field interlace it directs: random or 2:1 interlace. Sharper picture definition is obtained from 2:1 interlace (Figures 5a and 5b). Most cameras generate random interlace sync if they have internal sync, but can take 2:1 interlace sync from an external source. At least one camera (GE TE33D) can drive additional cameras through its sync. Most video tape recorders and special effects generators, and some video switchers, contain their own sync generator; they distribute sync signal directly to the camera(s) through a multi-conductor cable. Most separate component sync generators are designed to drive a fixed number of cameras; this component is connected into the system between the camera(s) and VTR. In any case, if more cameras are used in the system than the sync source is designed to accommodate, a Pulse Distribution Amplifier must be added; this component will distribute the sync to the extra camera(s).

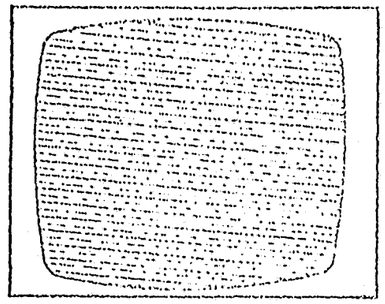

Figure 5a 2:1 Interlace

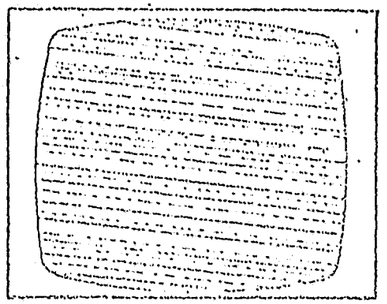

Figure 5b Random Interlace

b) A video switcher allows an operator to select the camera view he desires, and send that signal to a VTR for recording (or directly to a monitor). Video switchers range widely in the number of cameras they can handle; the number can vary from three to twenty or more. Some video switchers dispense sync signals, while others simply select the video signal (example: Vicon). Most video switcher units are passive mechanical switchers, are audibly loud during a switch, and are subject to picture roll because switching intervals are made randomly. Another type of switching, vertical interval, is quieter and more accurate, but is also much more expensive.

c) A special effects generator SEG is a video component which allows the operator to combine video signals of two or more cameras. Effects which can be produced may differ between brands, but most offer corner inserts, split screens, fades, and horizontal and vertical wipes. Some special effects generators include a preview circuit; this allows

the operator to set up the effect to be recorded, prior to sending this effect to the video tape recorder. Use of a preview function requires an extra monitor in the system to view the effect. A preview function adds approximately 33% to the cost of a special effects generator. Most SEGs include a sync generator and a video switcher; more expensive ones will also accept the video output signal of another video tape recorder or player. SEGs with color capability cost approximately 50% more than black and white SEGs. A fully loaded SEG may include outputs to the monitors for each camera, output to a preview monitor, line output for a VTR, a sync generator with 2:1 interlace, a vertical interval camera switcher, special effects selection for any two cameras, and special features such as an intercom system and camera tally light source.

d) A time/date generator is a video component which superimposes a clock referenced index display over the recorded scene. Security of recorded material is enhanced because a time/date generator usually superimposes year, month, day, hour, minute and second over the scene at the time it is being recorded, precluding later undetectable tape tampering. Sometimes, time/date generators allow selection of black or white number, (reverse polarity of signal), and variability in character size and placement in the picture. The time/date generator is connected between the tape recorder and its video input source, usually the camera.

6. Microphone and Mixer

The microphone, the first step in the audio line, transfers sound into electrical impulses for storage. Microphones differ primarily in pickup pattern. An omni-directional microphone has a pickup pattern of 360 degrees while a cardioid (uni-directional microphone has a pick up pattern of approximately 190 degrees. A super cardioid microphone has an even smaller pickup pattern (Figure 6). A lavalier microphone, usually omni-directional, is hung suspended around a speaker's neck.

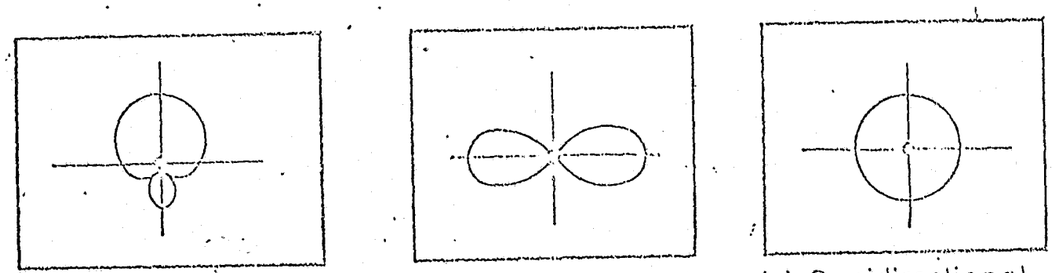

Figure 6
Microphone Pickup Patterns

Microphones are either balanced or unbalanced cable lines. A balanced line has a three conductor wire between the microphone and recorder. One inner wire acts as a "hot" conductor, the other inner wire acts as a return (common) conductor, and the braided outer shield acts as a ground to minimize pickup and hum. In an unbalanced system

there is only one inner conductor, which acts as a "hot" conductor, while the return path conductor is also the outer shield and ground.

Impedance properties of microphones are divided into two groups: high and low impedance. High impedance microphones are usually unbalanced and low impedance microphones are usually balanced; an example of a deviation from this rule of thumb are Sony microphones which are low impedance (600 ohms) but are unbalanced.

Microphone design is as varied as the uses made of them. Condenser microphones require a small battery to activate the pickup portion of the microphones; dynamic microphones use a magnetic field to activate the pickup portion of the microphone. A shotgun microphone is designed to capture one person's voice from a distance; for this, it must have a highly directional pickup pattern (example: Electrovoice 644). Wireless microphones which require an FM receiver for each microphone can be very expensive if chosen for quality and reliability; even so, they are subject to electrical interference and two cannot be used together on the same frequency.

Microphone stands are also designed according to use, but can be divided into two general groups: floor and desk stands. Floor stands simply elevate a microphone from an independent base of support; as such, they do not have to contend with noise transmitted through the support medium itself. Desk stands do have to contend with this kind of noise (desk bumping or tapping); as a protective noise absorber some stands use a thick, soft, rubber pad between the desk and microphone stand (example: Shure S055P isolation desk stand). Some desk stands

incorporate on/off switches in the base of the stand (in addition most microphones include an on/off switch in their own base).

A microphone mixer is the audio component of a video system which combines signals from more than one microphone prior to recording. A single "mixed" (combined) audio signal is then sent to the recorder. Each input to the mixer has a volume control to allow the operator to boost or reduce the signal strength of each input microphone. Other features which may be found on mixers are: VU meters to monitor the strength of the incoming signal, high and low impedance input and output, and headphone outputs.

7. Production Control Console

The production control console is the combination of control components within a video system which directs the flow and quality of recording. Effective operation requires that all control components be centralized in a convenient arrangement around the equipment operator. Consoles primarily differ in the number of cameras and microphone inputs and the sophistication of the special effects generator, but most will include: camera monitors for each camera, to display the scene being picked up on each; a special effects generator, to combine signals from several cameras, or a video switcher to select between camera views; a preview monitor, for setting up special effects if they are being used; an audio mixer, to combine signals from several microphones; and a time/date generator, to superimpose a time-based reference and security key. The console will be directly linked to the video tape recorder(s).

B. Effect of Application/Environment on System Selection

Selection of specific video components for a video system depends upon the intended application and the recording/playback environment. Each type of application, e.g., pre-recording depositions/testimony, pre-recording evidence, or recording court proceedings, will suggest specific recording techniques and procedures. These recording techniques and procedures include camera perspective (jury or judge view), extent of closeups (zooming, and how close a shot), following activity (follow conversation), establishing shots (on-camera identifications), use of special effects (inserts and split screens), operator certification, handling of completed tapes, tape duplication and editing. These, in turn, suggest specific system components. However, optimum techniques and procedures from a production standpoint will not necessarily coincide with what trial and appellate courts ultimately define as legally acceptable; component selection may require modification as a result.

To date few video recording techniques and procedures have been reviewed and validated or rejected; only a handful of case decisions exist which include comments on video recording issues. Through advice and comment from its Video Advisory Committee and other members of the legal community, the Video Demonstration Project sought to select and use alternative techniques and procedures when recording. This provided the legal community with a range of case applications to comment upon; unofficial responses were used to help define equipment performance requirements and aid in equipment selection, but official appellate comments await development of case appeals. Several of the project cases are only now being perfected on appeal.

Each video system configuration also must be tailored to the recording and playback environment in which it will operate. Recording of depositions/testimo:

may take place in a studio, courtroom, home, hospital room, office, or any other remote location. Recording of evidence may take place in a line-up room, interrogation room, or may be done at a remote location. Most external lighting can be eliminated by shading outside windows and neutralizing reflective surfaces such as shiny marble or wood table tops. Lens focal length will be determined by scene size and the recording procedure used. The lens focal length chosen should enable all of the scene to be captured without sacrificing loss of detail in facial expressions, except for when an overall establishing shot is desired. In many situations the scene is so large that a wide angle lens will generate poor resolution of subjects in the scene. Here, two or more cameras should be used. Also, a variable focal length (zoom) lens should be used when recording procedures call for both closeup and wide angle shots from the same camera.

Proper microphone selection assures an even generation of quality audio. By choosing a microphone pickup pattern which will best fit into the recording environment (local noise, movement of parties, etc.), accurate and even generation of audio can be produced. In noisy recording environments, a non-directional microphone will pick up more noise than a directional microphone. However, movement of a speaker to another postion may take him from the pickup pattern of a directional microphone; in these situations, proper microphone placement is necessary. Proper placement will eliminate the possibiljty of the speaker leaving the pickup pattern by providing pickup pattern overlap.

Monitor selection will also be affected by the recording and playback environment. When recording conditions require the use of two or more cameras,

it will be necessary to switch between cameras. To assure timely switching, the system operator will need a monitor for each camera, showing each camera's view. If a SEG is used for switching and special effects, use of a preview monitor will enable the operator to set up the effect prior to recording. Playback monitor selection will hinge on an evaluation of the potential for local RF interference from improperly operated high frequency radio equipment. If RF interference is of little concern, RF distribution can be used during playback. This yields the advantage of being able to select receivers instead of monitor/receivers, and of having to run only one cable in the distribution system; cost savings will result since receivers are usually isgnificantly less expensive than monitor/receivers and cable cost is one-half of what it would be for Line distribution (two separate cables, one each for video and audio, to a monitor).

C. Maintenance Procedures

Every video system user should institute a maintenance program of routine equipment cleaning and checking; if the equipment operator does this regularly, equipment breakdowns will be minimized, problems will be identified before becoming serious, and production quality will be consistently high. All such programs should insist that the equipment operator thoroughly read all instructional material for system components before attempting to use the system. Each time the equipment is used, an operability test of the video system should be completed prior to actual recording or playback. Inspection of system components and connections should be undertaken as an operating routine. Equipment should be dusted and cleaned often; dust may cause equipment damage as well as loss of recording quality. A regular

schedule of necessary maintenance should be established and maintenance records should be kept.

To supplement this maintenance program, the remaining discussion suggests specific procedures for monthly, weekly, and daily maintenance. On a monthly basis, operator maintenance should include a complete inspection of: connections between components, for looseness; power plugs, for signs of oxidation; and cables, for fraying and breakage. Each component should be inspected and cleaned thoroughly. Problems noticed should be logged and corrected.

On a weekly basis, operator maintenance should include a complete cleaning of the recording area. Shelves and storage areas should be dusted and cleaned. Camera lenses should be inspected and cleaned with a lens brush. The VTR and other components should be cleaned with a fine-fibered, dust collecting cloth and a cleaning solution which does not leave residue. Tape heads and other mechanisms along the tape path on the VTR should be cleaned with a fine cloth or other material which does not shed lint or fibers. Video and audio heads should be cleaned with a magnetic head cleaning solution, the application of which should be in the direction of tape travel, not in a vertical direction.

On a daily basis, prior to recording, operator maintenance should include a check for collection of dust, tape oxide or any foreign material on the video or audio components. Any problems noticed should be corrected. Empty reels should be cleaned after inspection for irregularities such as warpage and dirt or oxide collection. Reels of video tape should be checked for irregularities such as a difference in winding pattern or warpage. Tape should be threaded onto the VTR immediately after opening and inspection.

When handling, the reel of tape should be held by the hub to avoid tape edge damage and resultant loss in video quality. Tape threading onto the VTR should be done smoothly, avoiding touching portions which will later come into contact with the heads. Fingerprints include fat (lipids), which attract dust or lint. Tapes should never be threaded onto a VTR when heads are spinning or the operation lever is in any position other than the stop mode.

A test tape should be made prior to recording, to insure that the entire system is operating properly and producing the desired quality. Microphones and cameras should be checked and any irregularities logged and corrected. When operating the system, care should be taken in the use of the VTR transport controls during mode selection (start, fast-forward, rewind). A moving reel should be completely stopped prior to changing direction. Never put any pressure on the video head cover or store a VTR with a reel of tape in the machine. Always cover a VTR after recording or playback is completed. Turn off power to all machines after use, and cap camera lenses after turning the cameras off.

D. Storage and Shipping of Videotape

Storage of recorded tape must not only safeguard against damage, but must also provide for an efficient means of retrieval. In storing videotape, existing methods and space should be utilized whenever certain minimum tape storage and environmental standards can be met. The minimum standards to be met are storage in a clean place, free from dust, with temperature of approximately 70° ± 5° and humidity of 40% ± 10%.[1] These requirements are not difficult; the extensive volume of space needed for this medium

1. From interviews with video vendors and "The Video Handbook", Media Horizons, Inc., 750 Third Avenue, New York, N. Y. 10017.

would be more of a concern. The plastic container most videotape comes in is a sufficient protective storage container; this will protect the tape from physical damage and dust or dirt. If the tapes are going to be stored for a long period of time, they may be heat-sealed in a plastic bag for further protection and security. Tapes should be stored on edge; stacking tapes in a flat position may cause tape edge damage. The use of polyester backing on most modern videotape eliminates the need for periodic rewinding. Accidental magnetic erasure of videotape is not a problem as long as the storage area is not in the immediate vicinity of a very strong magnetic field (such as industrial magnets); tapes could even be stored in the normal office environment without fear of damage and magnetic erasure.

In setting up a storage facility for videotape, attempts should be made to fit the videotapes into the existing index and retrieval design. However, proper retrieval dictates that each tape contains at least: an index number, such as case number; name of case; date of case; and the reel number, such as reel 2 of 5. This information should and can easily be placed on the outside of the protective cover as well as on the reel hub. Each container should have this additional printed information placed inside: tape format, such as 1/2 inch EIAJ-1; black and white or color; tape length, in time; and special legal information, such as witness name or charge. Most important, a log of events indexed in reference to an internal timing device on the tapes (clock to seconds, or time/date generator) should be included in the container for reel number one; this log should cover all reels. Another copy should be kept with other legal papers. If the tape is part of a case record or evidence, the case file should include a special notation card to mark it as a case that involved the use of videotape;

this card should be cross-referenced to the retrieval system. If the retrieval system uses index cards with the storage system, that index card should also clearly state that the record or evidence is stored on videotape.

Shipping of videotapes may often occur, especially between courts; special care should be taken in shipment of videotape. Heat-sealing the tapes in a plastic bag will insure that the tape will not be damaged if left in the rain or humid, damp areas. Housing the tape in a three inch deep protective container will insure against accidental erasure, even if the tapes are placed next to a magnetic field during shipment; this type of container will also provide physical protection. Extreme temperatures could be encountered in shipment, particularly during air shipment. Although temperatures less than 250°F will not damage the tape, playing a tape when it is very warm or very cold could harm it. For this reason videotapes should be allowed to adjust to room temperature before use. One final caution: many airlines are now using special electronic beam devices to x-ray the contents of carry-on baggage without having to open the container. Although the automatically timed electron beams do not affect film and are said to be of insufficient duration (1/10,000 second) to develop a local magnetic field strong enough to disrupt a videotape's magnetic pattern, the same can not be said for manually operated devices which could easily stay on much longer. The safest approach is to send any self-accompanied videotapes as hold baggage.

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