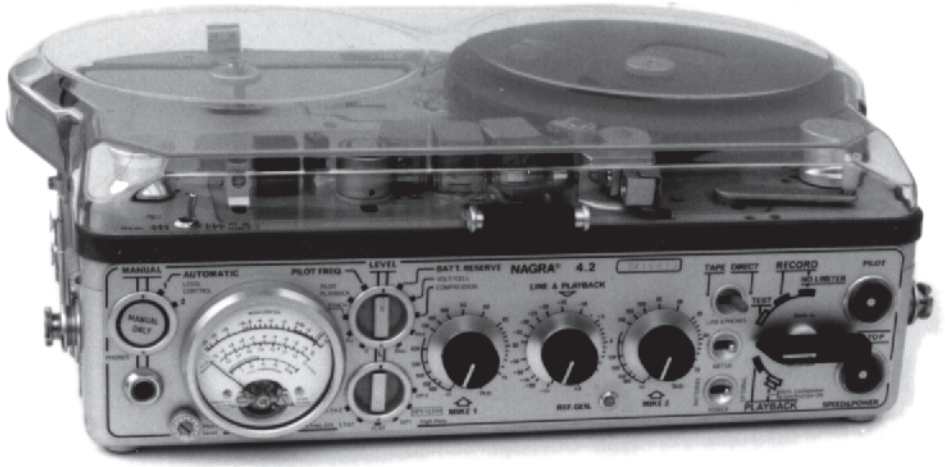
Guide to the Nagra 4.2 and Production Sound Recording

2nd Edition



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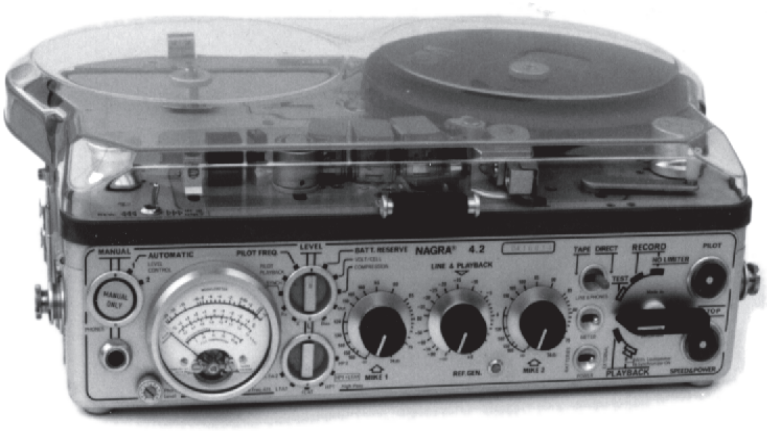
Preface

This publication is a compilation of articles dealing with Production Sound Recording for Motion Pictures and Video. It includes the popular "Guide to the Nagra 4.2" operations manual along with an assortment of short pieces covering various aspects of sound recording for film and video. Many of these articles were originally published independent of each other in trade magazines, so it is not unusual to find some redundancy. I have opted not to include operating guides for recent digital recorders since PDF versions of the original manuals can be downloaded from the manufacturers websites. Manufacturers' brand names and model numbers are the registered trademarks of those respective companies.

Contents:

UNDERSTANDING AND OPERATING THE NAGRA 4.2 SYNC RECORDER

written by Fred Ginsburg, C.A.S.



The Standard for Film Production

The Nagra audio recorder has been and still continues to be a world-wide standard for use as a portable tape recorder for sync dialogue. Since the early sixties, the Nagra has been the recorder of choice for motion picture production, and has been unchallenged until recently with the introduction of timecode DAT recorders. In 2002, Nagra recaptured a portion of the digital audio market with its introduction of the Nagra 5 digital timecode recorder with removable hard-drive.

Although DAT recorders have better audio recording specs than the basic Nagra, the current crop of DAT's are nowhere near as dependable under diverse conditions and lack many of the convenient features that the Nagra offers, such as **confidence head monitoring** (you can listen off of the tape that was just recorded a moment before to insure that what you heard is what you got); **excellent microphone preamps** (the mic pots on a Nagra are as good as any found on a mixing panel; something that cannot be said for DAT recorders); and **long play battery life** (days on one set of D batteries as opposed to an hour or so offered by DAT recorders).

Despite the Nagra's compactness, it rivals full blown studio machines for recording quality. More importantly, the Nagra recorder is extremely **rugged** and continues to operate in perfect spec even under arduous location conditions! (Something that cannot be said for most DAT recorders.)

Unlike studio recorders that require daily adjustment, the Nagra is able to maintain its high quality of recording with but **minimal maintenance** once or twice a year. Nagras have been known to go for several years without any maintenance and still function almost perfectly, although it is a poor professional practice to be so negligent in the care of one's equipment.

The Nagra is so much the industry standard for motion picture production that the brand name has literally become synonymous with the term "portable sync recorder".

It is not uncommon to be asked, "What are you using for a Nagra?" Which means, what type of Nagra are you going to use for sync sound, or are you going to use a sync cassette recorder, etc.

Nagra, by the way, literally means *record* in Polish. Stephan Kudelski, the inventor of the Nagra, is Polish. The Kudelski/Nagra factory is located in Switzerland.

As an aside, during the preparations of the 1984 Olympic Games, when it seemed like every company under the sun was the official this or that sponsor, we used to kid the local Nagra staff that they should commission a poster proclaiming "Nagra, the official Nagra of the 1984 Olympics!"

Various models of the Nagra

Historically there have been three significant models of monaural machines, and two models of stereo recorders.

The first practical Nagra was the **model III**. The Nagra III was very reliable, and to this day is still found in many sound studios as a transfer deck to sprocketed mag film. The III relied upon external sync reference (umbilical cords from the film cameras), but most machines have long since been modified with crystal sync.

In the early days of Eclair NPR and Arriflex 16BL film cameras, sync between the camera and recorder was maintained by a "**sync cable**" that linked the two together. A **60 cycle sync pulse** was generated by the camera motor, and this signal was recorded on the Nagra as an indicator of the exact film speed. Due to motor and battery variances, the film speed tended to vary slightly, and the 60 cycle sync pulse would reflect these speed changes.

The eventual advent of crystal controlled camera motors eliminated any film speed variance, and so the physical linking of camera and sound recorder became unnecessary. The Nagra took its sync reference from its own crystal regulated sync pulse generator.

The model III offered only one mic input, plus one line level input (adaptable to mic level), and required an external resolver for sync playback. It also required a dual banana jack adapter for headphones.

The next generation of Nagra was the **model IV-L**. The IV-L looks somewhat similar to the model 4.2, and features two microphone inputs plus one line input. The IV-L features internal crystal sync and also accepts an internal resolver circuit board.

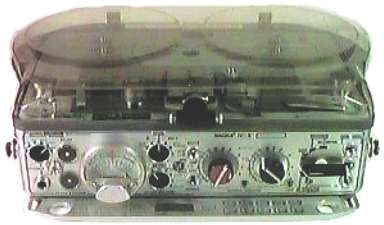
There is a "dangerous" position on the main control switch of the IV-L which activates the **RECORD** mode, but at very reduced levels. This unlabeled **FADE RECORD** position is between **TEST** and **RECORD**. This was intended as some sort of "fade in" mode for European users, to create a soft start for their recordings (Why?). Many Nagra users have made the horrible mistake of thinking they were in the regular **RECORD** mode when actually they were only in the **FADE RECORD** position, thus rendering their recordings unusable.

If you own a Nagra model IV-L, have a technician permanently disable that switch setting and jumper it for regular RECORD.

The **Nagra IV-S** was designed for stereo recording, but still utilized a 60 cycle sync pulse. However, the sync pulse system on a stereo is very different than that found on a monaural machine, and the formats of recorded tapes are not interchangeable between mono and stereo machines.

Tapes recorded on any of the mono Nagras are fully interchangeable with any other model mono Nagra.

The Nagra IV-S requires an external resolver, and special input cables for line level input (with 47K ohm resistors). Almost no one uses a IV-S these days.



The stereo Nagra of choice was the **model IV-STC**, which is a Nagra IV-S that has been designed to record SMPTE time code in the track area formerly used for 60 cycle sync pulse. The model IV-STC is more complicated to learn and operate, and will not be dealt with in this chapter.

Other models of Nagra recorders include the **E** (a non-sync recorder); the **IS** (stands for idiot simple; European idiots must be of a higher mental caliber than American idiots since it never caught on in the

U.S.); and the **SN** (a miniature recorder originally developed for the cloak and dagger crowd, rendered obsolete by radio mics and miniature DAT recorders). The model **T** is a large, studio timecode stereo recorder, compatible intended for use with telecine transfers and post-production. The Nagra **model D** is a four-track reel-to-reel digital timecode machine. The newest Nagra is the model **5**, which is a digital stereo timecode portable recorder that utilizes a removable (expendable) hard-drive.

By far the most common Nagra in filmmaking is the model 4.2L. This is the pinnacle of the mono machines, and is the standard to which all portable sync recorders are compared.

The Nagra 4.2 offers two microphone inputs, plus one line level input, and features internal crystal sync and internal resolver. It is still used by the majority of television series as well as many independent feature films.

Weighing under fifteen pounds including batteries, and measuring approximately 13" x 10" x 4.5", the Nagra 4.2's recording specifications at 7 ½ ips are:

Wow and Flutter: 0.03%
Freq. Response (at 20 dB below peak level): 30 Hz to 15 kHz +/- 1.5 dB
Signal to Noise: 73 dB

Bear in mind, of course, that these specifications are both conservative and applicable to full spectrum music recording. When used for the recording of simple speech (dialogue), the results are even more impressive!

What is Sync Sound?

In **single system** filmmaking and video, the location audio track is physically recorded on the same piece of film or videotape as the picture. In essence, the camera or VTR serves records both picture and sound simultaneously.

Double system filmmaking involves the process of **recording audio separately from the picture**, by means of an isolated audio recorder. Dailies, screenings, and editing take place with picture and audio on separate physical reels, projected and played back in "sync" by means of interlock. Double system provides the editors with a great deal of creative options. At the completion of all post-production, the separate reel of audio is physically merged to the picture in the form of a composite print (single system), featuring picture and sound adjacent to each other on the same reel.

Double system recording is not just limited to motion picture production. Sometimes in video production it is preferable to record the audio separately from the video, and a sync recorder such as a Nagra, DAT, or multitrack is used for that purpose. Rationale for double system recording in video includes: concert recording, protection backup tracks, audio only interviews & sound effects, and closer physical placement of the audio recorder/microphones than where the camera might be located. When dealing in terms of older camcorders whose technological achievements were limited to picture at the expense of audio, double system recording has very obvious benefits.

Talking about sync and achieving it are two different things!

In the old days, sync between camera and sound recorder was maintained by electromechanical means. Sound was recorded directly onto sprocketed magnetic film, with one frame of picture corresponding to one frame of sound. Tape recorders were the size of telephone booths and had to be kept outside of the soundstage either in another building or in a large truck. Large 3-phase power cables connected the recorder with the camera, and literally drove it sprocket for sprocket in sync with the sound.

Later systems utilized synchronous motors, with both the camera and sound recorder running locked to the 60 Hz frequency of common AC electrical current.

In the sixties, Stephan Kudelski and Loren Ryder introduced Hollywood to a new way of doing things. Location sound could be originally recorded onto a lightweight ¼-inch tape recorder, and then later transferred to sprocketed magnetic film for editing and rerecording (mixdown).

Sync between the film camera and the tape recorder was achieved by a system known as **neopilotone**. Again, both the camera and the sound recorder took advantage of the 60 Hz frequency provided by running off of common AC electrical current.

But since the Nagra did not utilize sprocketed tape, it had to rely upon neopilotone to achieve sync. The way the system works is that a 60 Hz sync pulse (in actuality a sine wave) is recorded onto the center of the audiotape. When the recording is later played back for transfer, a special device known as a **resolver** compares the **sync frequency** (sync pulses) on the tape against an external reference (another 60 Hz signal). The resolver speeds up or slows down the tape speed so that both 60 Hz signals match up. The resolving process compensates for errors such as tape stretch, slippage, and minor motor fluctuations.

We do not normally hear the 60 Hz sync pulse (hum) on the Nagra tapes because a second 60 Hz sine wave is simultaneously recorded onto the tape. This second sync pulse is a mirror image twin (180 degrees out of phase) of the first sync pulse. When the two sync pulses are played back over the head together, they cancel each other out.

That is why you ***will hear*** the sync pulse if you play back a full track Nagra tape on a quarter-track or half-track recorder.

If you attempt to razor blade edit a tape recorded with a Nagra, you will hear noise at the edit points when you make a diagonal splice, since the diagonal cut eliminates part of the mirror sync pulse that otherwise functions to cancel out the primary sync pulse. When using a Nagra for non-sync recording, such as radio interviews, merely **remove the crystal jumper plug** from the right side of the machine to prevent a sync pulse from being recorded that might interfere with any future (razor blade) editing.

It is very important to realize that Nagras do not run at 24, 25, nor 30 *frames* per second! They run at 7 1/2 *INCHES* per second. It is the FILM CAMERA that runs at frames per second, and then later it is the MAG FILM RECORDER that will record at frames per second to match the film camera. But as far as the Nagra is concerned, there are NO FRAMES per second, only inches per second **IN REAL TIME**.

What this means is that the crystal sync pulse system is intended to replicate or **reproduce a recorded event in precise real time** — no longer and no shorter than the actual elapsed time.

If we were to film a scene that ran 10.00 seconds with a crystal controlled film camera running at 24 fps, and then projected that same strip of film at 24 fps, we would re-create an event of 10.00 seconds duration.

During the same production, if we were to record audio of that 10.00 second event, we would require that the audio recorder be able to play back that sound in precisely 10.00 seconds. Any longer or shorter — due to tape stretch, slippage, or motor variation — would result in a loss of lip sync.

The Nagra is capable of reproducing those 10.00 seconds by means of recording a sync pulse (generated by a crystal clock) onto the original tape, and then comparing (resolving) that sync pulse to a reference sync pulse (such as that same crystal clock). The tape speed is minutely adjusted so that the sync pulses match up. The end result is an audio event of 10.00 seconds. Real-time.

So where do the frames come in? At the same time that the Nagra plays back the audio in real time, a sprocketed MAG FILM recorder is running at the same frame rate as the camera originally did. The audio (10.00 seconds) is recorded onto a film strip with sprocket holes that is running at frames per second.

Question: If the Nagra is running at crystal controlled real-time, what is governing the speed of the mag recorder during the transfer?

Some mag recorders are crystal controlled, but many of them take their speed control by the 60 Hz frequency generated by our AC electrical system. Since the mag recorder and film projector are both referencing the same AC frequency, any variations in that frequency that may occur in the power line affect both machines the same, so lip sync is maintained. When audio is transferred from a crystal Nagra to a mag recorder locked to AC, we use a special AC power adapter (called the **ATN**) to both power the Nagra and to provide an external sync pulse reference taken from the AC line. This external reference locks the Nagra to

the same (possible) fluctuations that may affect the mag recorder and projector.

The resolver in the Nagra will adjust the play back speed of the tape to match any variations in the frame rate of the mag recorder. Real time has now been superseded by projection time. For example, our 10.00 second scene may end up projected at 10.09 seconds, a slight variation of 24 fps. However, the mag recorder is locked to the same AC line, so it too would be running slightly off from 24 fps to match the projector. Our Nagra, locked to the same AC line, would be adjusting its speed so as to match 10.09 seconds of "real time".

The Nagra deals with record duration and play back duration. Seconds, not frames.

It does not matter what frequency sync pulse is used during the record process, so long as that same frequency is used during the play back process. 60 Hz is the norm in the United States, and 50 Hz is the norm in Europe. Most Nagras have an internal switch to change from 60 Hz to 50 Hz.

But if a mistake is made, and the Nagra crystal is left on 50 Hz during one's shoot, it is not a major problem. British film cameras may run at 25 fps, but the audio still runs in real time! As long as the Nagra is resolved to a 50 Hz crystal reference, it will play back in precise real time, and lip sync is preserved during the transfer!

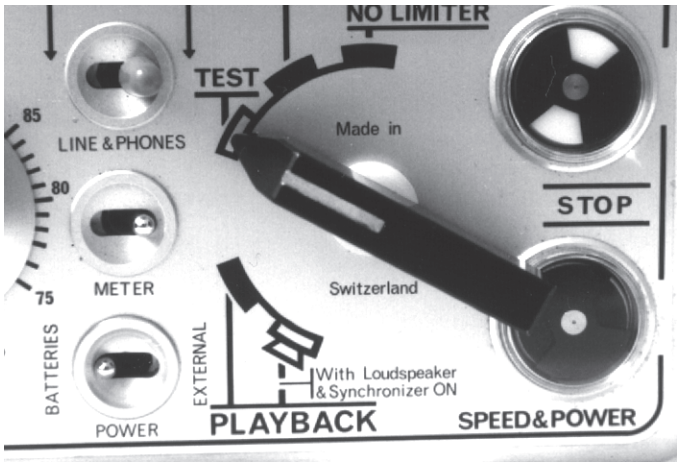
If a Nagra crystal goes sour, and records a 47.8 Hz sync pulse, there is still no problem. Just make sure that you use the same machine to transfer from, and let the Nagra use its same (albeit defective) 47.8 Hz internal crystal for reference. Real time will be maintained! Ten seconds of picture will equate to ten seconds of sound.

The only time that transferring becomes complicated is when we alter the real time relationship between the film camera and the recorder, such as when we transfer negative film (shot at 24 fps) to video via a telecine that slows the film down to 23.97 fps. If the audio is being transferred directly to video (instead of to a sprocketed mag recorder), then we need to fool the Nagra into slowing down by the precise same percentage. We do this by feeding the Nagra an external sync reference slower than the original 60 Hz we used during recording. In the case of film to video, we would feed the Nagra a 59.94 Hz reference, and that would adjust for the film speed slow down.

The key item to remember is that as long as the film camera is crystal controlled, it does not matter what the frequency is of the sync pulse that is recorded on the Nagra, just so long as that same frequency is used during resolve play back.

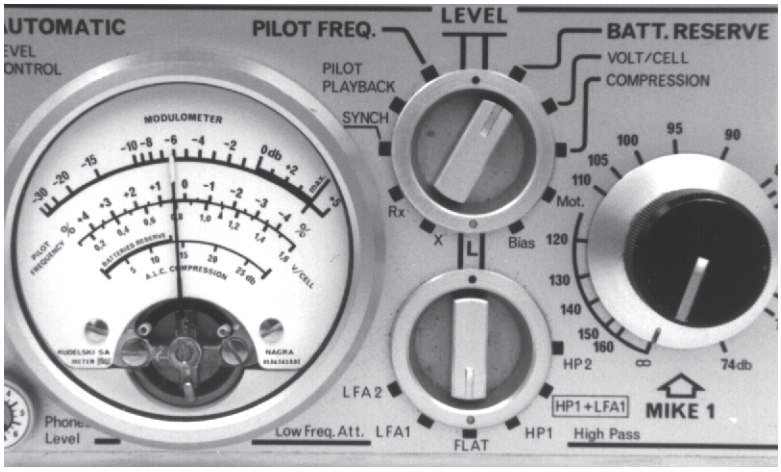
Operation of the Nagra 4.2L

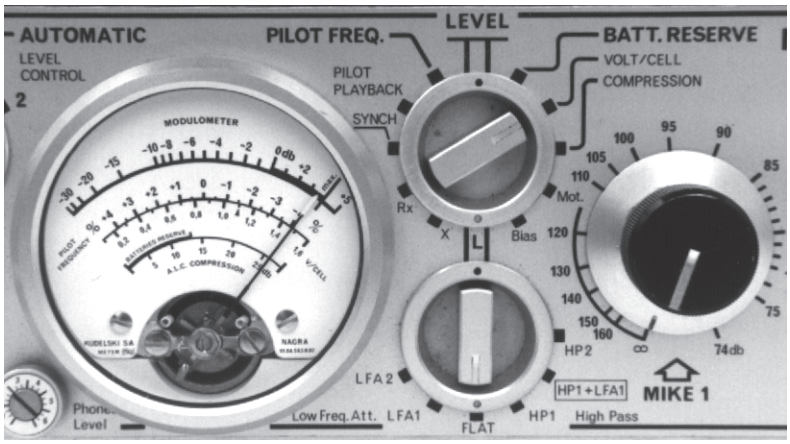
Turn it ON and check the Batteries



The first thing to do is to turn the Nagra ON. Do this by flipping the power switch on the front of the machine from **EXTERNAL** (off) to **BATTERIES** (on).

Next, we want to verify the condition of the batteries. Turn the main selector switch up to **TEST**. Turn the **METER SELECTOR** to **BATT RESERVE** and look at the lower line of the meter. If the needle rides in the rightmost portion of the thick black line, you have good batteries. If the needle rides in the left third of the black line, you have weak batteries. If the needle is somewhere in the middle, you have "somewhere in the middle" batteries!





Okay, you're saying, "Cut the sarcasm. What do you mean by *'somewhere in the middle batteries'*?"

Well, that's the problem. The **BATT RESERVE** indicator is only good as a quick check, and does not really tell you very much.

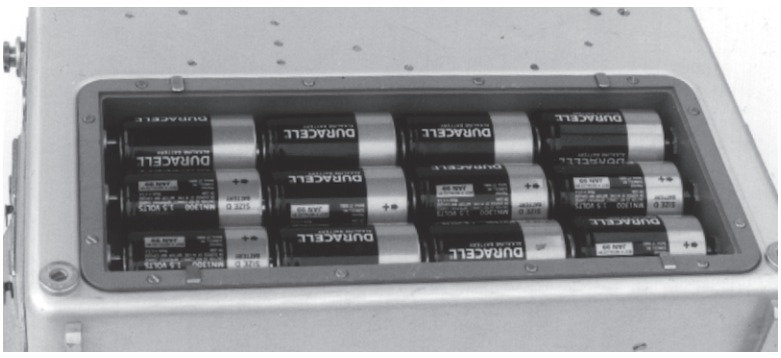
But the next click down is the **VOLT/CELL** indicator. This is the position to use for checking batteries. It will display a very precise readout of the average volts remaining per battery, and is read on the middle scale of the meter. Markings range from 1.6 downward. Brand new D batteries should read around 1.5 or higher.

Note that there is a **caret** (triangle) at the 1.1 marker. This is the lowest voltage that will still operate a Nagra. At this point, the motor speed will begin to fluctuate, and lip sync may be lost.

The 1.1 marker is not a warning, but a **PROMISE** of bad things to come. Do not ever allow your batteries to get that low. If the producer is paying for the batteries, change them at 1.3 volts per cell. If you are really trying to stretch the budget, you can go down to 1.2 volts. No lower! Batteries wear down gradually up until 1.2 volts, then they deplete rapidly to 1.1 volts. Never press your luck; you will lose!

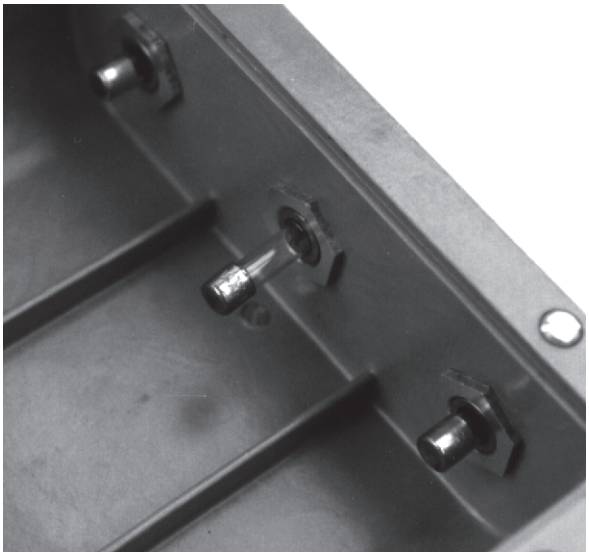
Batteries that have been resting for a few hours will read higher at first. **Check your battery level often, especially in cold weather.**

To replace your batteries, turn the main selector to OFF (nine o'clock position) and flip the power switch to EXTERNAL (just for extra protection). Turn the Nagra upside down, and use a coin to unlock the battery compartment.



Remove all of the old batteries and get them out of your sight! Give them to the crew for use in flashlights, or dispose of them safely. Do not put them back into a battery carton, lest they be mistaken for fresh ones later on!

While you have the battery compartment open, take note that there are three fuses located in the positive battery terminals. These fuses can be

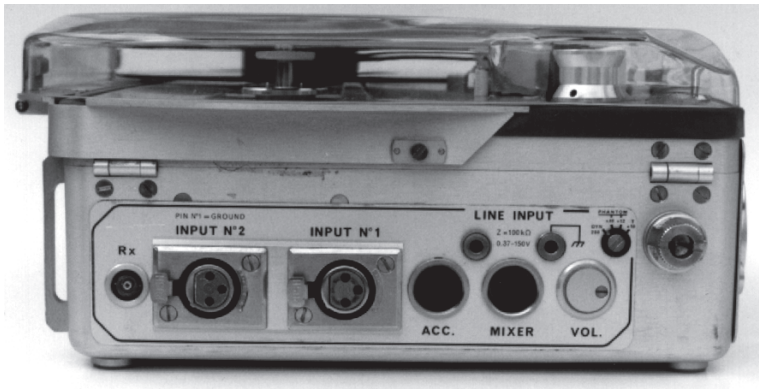


removed with your fingers and inspected. If they need to be replaced, use **2.5A 5x20mm**. These fuses will blow if batteries are inserted wrong, or if a battery reverses its own discharge. The sign that a fuse may be blown is if you turn on the machine and nothing happens. (Even weak batteries should make the needles move.)

Insert twelve NEW D cell alkalines (Duracell or Energizer are recommended). Be careful that all of the batteries are facing the proper direction! If the engraved battery icon on the floor of the battery compartment is hard to see, outline the plus and minus signs with a Sharpie marker.

Always use fresh, new batteries of the same brand and batch. Never intermix different brands, as the batteries will deplete at varying rates and cause electronic noise. I prefer Duracell coppertops because of their quality and the ease of visually ascertaining that all of the batteries are facing the same direction.

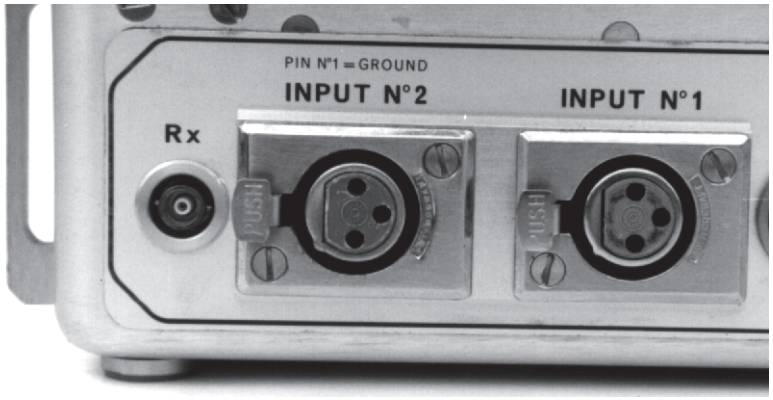
Replace the battery lid. Activate the power switch, go to **TEST** position, and check your **VOLTS/CELL**. Should be reading around 1.5 volts.



Nagra Input Side (left side)

Rx Socket

This was intended for some sort of European radio slating device that flew as well as the Spruce Goose. The socket is not wired to anything. Ignore it. Or mark it with a piece of tape to remind you to stop at the drugstore on the way home to pick up some more sunscreen!



Microphone Inputs

There are two mic level inputs. The levels from both connectors are controlled by the two **pots** (knobs) on the face of the machine. Both inputs are mixed together onto the samesoundtrack because this is a **MONAURAL** recorder. It does not matter which input you prefer to use.

Always keep the unused pot turned all the way off to avoid hiss.

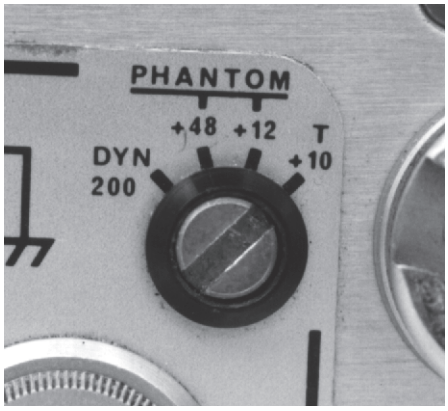
The **MIC inputs** accept professional, low impedance, balanced microphones with standard XLR 3-pin mic cables.

Nagra recorders can be equipped with a choice or selection of different microphone preamps inside the machine to interface with different types of mics. Make sure that you know which type of mic preamps your machine is equipped with, or else some mics will not work with your Nagra!

The basic mic preamp is known as the "**QPSE-200-XOYO**" and is found in most of the older machines. This preamp is designed for low impedance, dynamic (or self-powered) microphones. This preamp works with dynamic mics, electret condenser mics (that power from their own battery), and condenser mics (powered from an external battery power supply). The **XOYO** preamps do not provide any direct powering to mics.

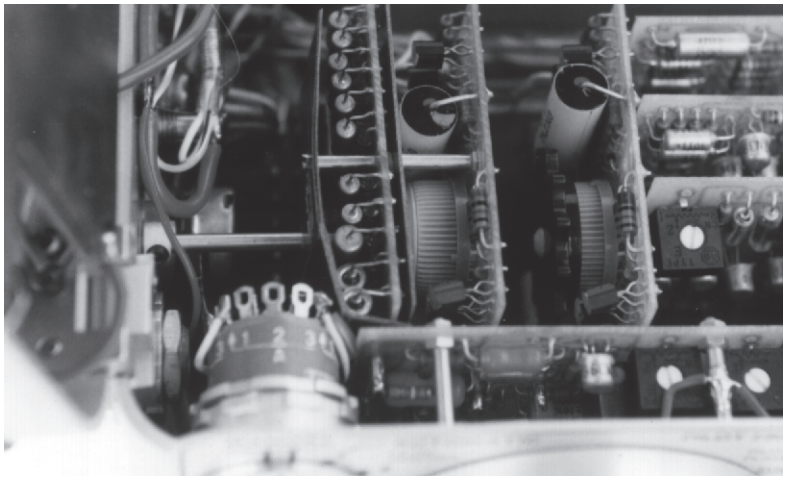
The next preamp commonly found in older machines is the "**QPM 3-5**". This preamp is designed to provide **12 volt T** powering to condenser mics such as **Sennheiser MKH416/816** shotguns. This preamp is incompatible with dynamic or self-powered mics! So although it may be convenient for powering the shotgun mic, the **3-5** limits the soundperson from using a lavalier or radio mic.

I do not recommend using a 3-5 preamp because of this limitation. It makes better sense to use the XOYO preamp and just tape a battery power supply onto the strap to power your condenser shotguns.

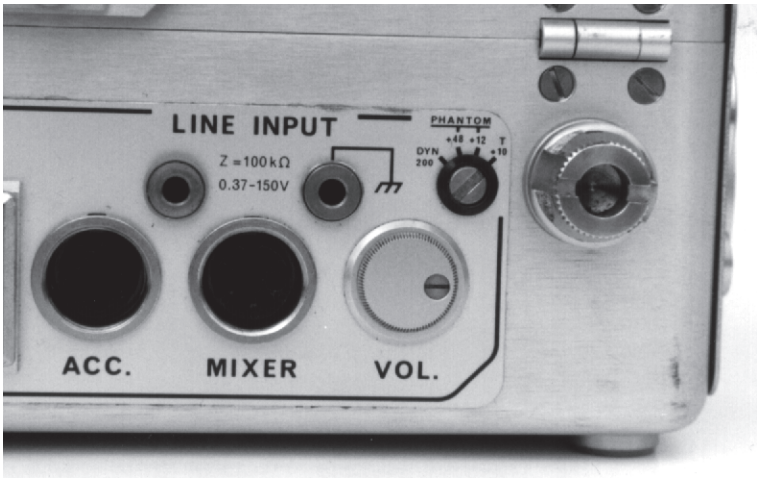


Newer vintage Nagra 4.2's may be equipped with one or two **UNIVERSAL** preamps. These preamps are user selectable for use with any microphone (dynamic, 48 volt Phantom, or 12 volt T). The "**QPAUT**" preamp is reserved for use in Mic Input One. It is controllable (and identifiable) by a selector screw located near the strap mounting screw and above the speaker volume control. Clockwise across the selector will read **DYN 200**, **Phantom +48**, **Phantom +12**, and **T +10**. The DYN setting is for dynamic and self-powered mics. Phantom +48 is for 48 volt Phantom condenser mics. Phantom +12 is for 12 volt Phantom mics, which you probably will never use. The T power setting is for condenser shotguns that use 12 volt T, such as the 416.

If, and only if, there is a Universal preamp in Mic input One, it is possible to install a second Universal preamp (known as the "**QPUT**") in Mic input Two. **The control for this second universal preamp is located inside of the Nagra, just behind the meter.** You will see a black plastic thumb wheel, with notches all the way around. This black wheel controls the second universal preamp. The position of the wheel (unmarked) corresponds to the labels on the selector for Mic preamp One (the screw selector on the side of the Nagra). Completely counterclockwise would be DYN. Completely clockwise would be T power. The two Phantom settings are in the middle.



One last word about Nagra preamps. Although the configurations for DYN and Phantom are normal, Nagra uses its own variation of 12 volt T power. Most T-powered mics, as they come from the manufacturer, require 12 volt positive on Pin 2, and 12 volt negative on Pin 3. **Nagras produce 12 volt positive on Pin 3 instead, and negative on Pin 2**. So to power a shotgun mic from a Nagra, it is necessary to switch pins 2 and 3 inside of the mic (known as "**red dotting**"), or to use a phase reversing cable that accomplishes the same thing. This is definitely confusing, but that's the way life is. If you are not sure which way your mic is wired, make sure that you bring a **phase reversing cable** with you!



ACC Socket

The next item on our guided tour of the Nagra 4.2 is the **Accessory Socket**. This socket is a 6-pin Tuchel connector (a real pain to find in an electronics store and a bigger pain to solder). The **ACC** socket provides a **line level input** to the Nagra, and the input level can be controlled by the center pot on the face of the machine. In addition to being a line input, the ACC socket also provides **10 volts output** for the powering of accessories.

This socket is normally used for connecting a mixing panel to the Nagra.

The ACC socket can also be used to **convert the line input into a third microphone input**. Accessories such as the **Nagra BS-II cable adapter** and the **Sennheiser KAT-15U** adapter plug in to this socket and provide an XLR input. The KAT-15U can also provide T powering for shotgun mics.

Mixer Socket

Contrary to its name, we **do not use the Mixer socket to plug in mixing panels!** This 7-pin Tuchel socket is intended for line level input of **calibrated level**. There is **no means of adjusting the input level** when using this socket. It was originally intended for a custom mixing board to be built by Nagra.

However, the Mixer socket does have its uses. It provides a **source of power out** for use with accessories. It can be used to **remote start/stop** the Nagra with a simple switch. The Mixer socket can also provide an **audio output** (monitor return) to a mixing board.

Banana Line Input

The two sockets located on either side of the Mixer Socket are the same line input as found in the ACC socket. Although some people mistake banana style sockets for a pair of RCA or Mini connectors, both of the banana jacks constitute only ONE input. Positive audio goes into one hole, and negative audio goes into the other.

Banana plugs are inexpensive to purchase and idiot simple to solder. One lead, one plug. For this reason, many mixers prefer to use the banana inputs rather than the ACC socket for connecting their mixing boards.

The input level of the banana jacks is controlled by the center pot on the face of the Nagra.

Warning: Use either the ACC socket or the Banana jacks for line input; but do not use them both at the same time!

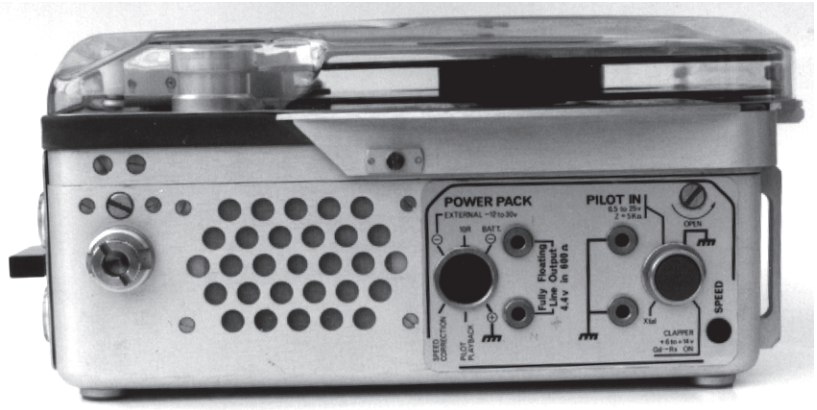
Volume

This knob controls the **volume of the internal loudspeaker** of the Nagra. The speaker itself is located on the other side of the machine (the output side). The loudspeaker only functions when the Nagra is in the Loudspeaker Playback mode (the lowermost playback setting of the main selector switch).

Universal Preamp Selector Screw

On those machines equipped with a Universal mic preamp, a selector screw with labels will be located just above and to the right of the volume control. See the section on Mic preamps for details.

Output Side of the Nagra (right side)



Loudspeaker

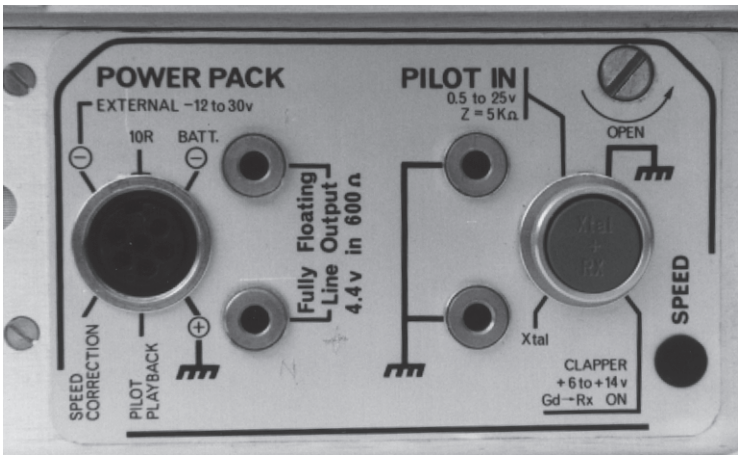
The loudspeaker is controlled by the volume control located on the other side (input side) of the machine. Loudspeaker is only activated during Loudspeaker Playback, which is the lowermost playback setting of the main selector switch.

Power Pack Socket

This is a 6-pin Tuchel connector. The external AC power supply for the Nagra, known as the ATN, plugs into this socket.

The Nagra can accept regulated external power of 12 to 30 volts, although 18 to 24 volts is preferable.

External speed varier plugs in to the Nagra here. Frankly, no one uses an external speed varier on a sync Nagra anymore.



It is also possible to tap into the battery supply of the Nagra. We know of an engineer who builds his remote start/stop switch by taking power out of the batteries, going through a switch, and then rerouting the power into the external power input.

Note: I do not recommend operating the Nagra in the field off of the ATN power supply or any other mains power supply. Anytime the Nagra is linked to common AC voltage on a film set, one risks power surges as well as noise coming down the line. (How do you think those plug-in room intercoms work?)

Also, should the ground isolation of the power supply fail, your Nagra may go up in smoke if there is any other AC powered equipment in contact (including audio/video connections) with the recorder. **Nagras are positive ground which is opposite ground of everything here in the U.S.**

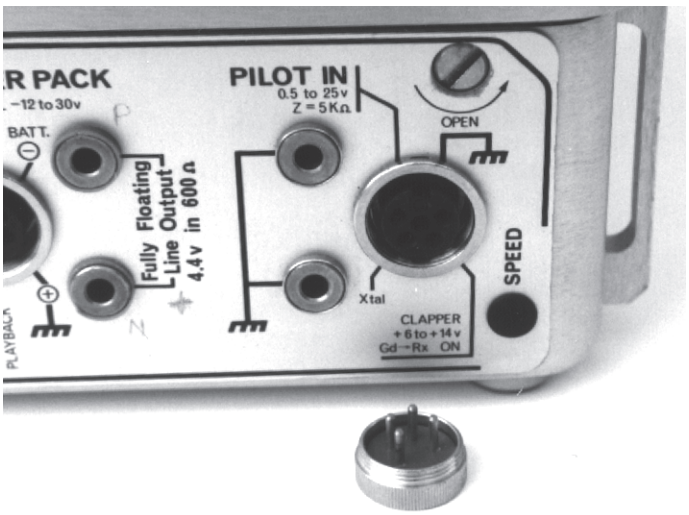
Reserve the use of the ATN mains power supply for use in the post-production studio where power is clean.

Line Output

These banana jacks provide the audio line output from the Nagra. These are **floating outputs**, so plus and minus doesn't matter. One jack goes to Pin 2, the other to Pin 3 of an XLR connection. Grounding points, if you want them, or located to the right of the line output jacks, just under the label "Pilot In". If you are connecting to an unbalanced plug, such as an RCA or phone plug, just connect the center or tip to one banana jack and the shield or sleeve to the other.

The line output jacks are used when we transfer from the Nagra to another recorder, or when we want to feed a studio amplifier for playback. The output level is 4.4 volts, which is pretty hot, so use your meters to level things off. Remember, that 0 dB on a Nagra is equivalent to around +10 VU on other recorders. Set -8 dB on the Nagra to 0 VU on other recorders.

The line outs are functioning during record, and can be used to feed a video assist system during the take. However, be forewarned that switching the headphone **TAPE/DIRECT** monitoring switch will also affect the output signal from these jacks. Monitoring off of **TAPE** lets the soundperson confirm what has just been recorded on the tape, and is a split second delay from live sound. Feeding video while in the TAPE mode will result in the audio on the VTR being delayed and thus out of sync.



Pilot Socket

Pilot is short for neopilotone, which is Nagra-speak for sync pulse.

Normally, there should be a capped jumper plug screwed into this socket at all times. This "**crystal jumper plug**" performs the following function: it redirects the sync signal from the internal crystal back into the Nagra system.

What? Remember, the Nagra was designed to accept sync pulse directly out of a camera or any other device. The crystal sync generator acts like a surrogate camera feed. During record, the Nagra outputs the crystal sync to the jumper plug, which then redirects the sync pulse into the pilot in of the Nagra.

During normal resolve, the output of the crystal becomes the external sync reference.

But sometimes during the record or playback process, it is necessary to use a different sync signal for the Nagra to lock up to, such as 60 Hz from an AC line, or 59.94 Hz for transfer to video, or camera sync from a special effects/process photography system, etc.

The internal 60 Hz crystal is disengaged by removing the jumper plug, and a different sync signal can be fed to the Nagra via this socket.

If the crystal plug is removed (or becomes loose) from the Nagra, and no other sync cable is plugged in to replace it, then no sync pulse will be recorded by the Nagra. This situation will become apparent to the operator because the pilot indicator flag on the face of the machine will not turn white, or may flicker!

Once sync on a take is lost, it cannot be added later. As my computer would say, "Fatal Application Error"!

If the crystal jumper plug is lost, it is possible to makeshift a substitute by securing a wire or paperclip between the pins labeled Xtal and Pilot In. Be careful that the repair is not intermittent.

The Nagra internal bloop slate is activated by passing 7 to 14 volts across the clapper pin and ground. Presence of DC current will make the Nagra record an audible bloop on the soundtrack for slating purposes.

In the old days of umbilical cord sync cables, cameras such as the Eclair NPR were capable of producing their own version of clapstick markers internally. Every time the camera was started, an internal light would flash the first few frames of film. Simultaneously, a current would be sent to the Nagra to activate the internal bloop generator, putting an audible start mark on the soundtrack.

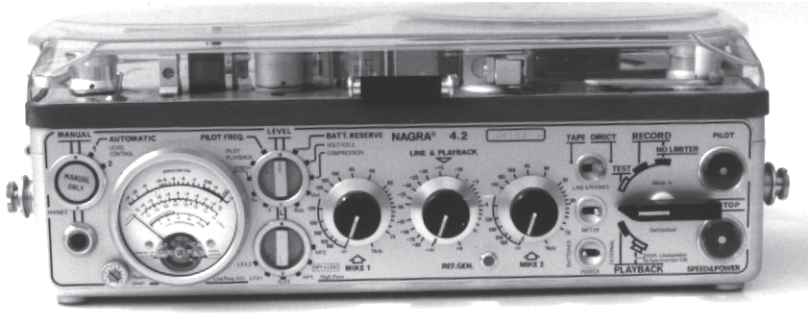
After the invention of crystal sync, documentary filmmakers began to use a silent clapstick known as a bloop slate or flashlight slate. These were small boxes that the soundperson wore. Depressing a button on the device would trigger a bright light that could be photographed by the camera at the same time that a bloop signal was recorded inside of the Nagra.

Transport Lid Screws

Located just above the strap lug and on the rear upper corner of the Nagra are the lid screws. Loosening these screws allows the upper Nagra deck to be opened, such as for accessing the second universal preamp. **Do not over loosen these screws, or their retaining nuts will fall into the machine.** Just turn them enough so that the lid will open upward.

Make sure that you are authorized to open up the Nagra. Some universities and rental houses frown against their machines being opened, and seal these screws with enamel.

Facing Panel of the Nagra



Automatic Level Control

Most machines do not have the **ALC** installed, and this socket is filled with a spacer plug. But there are some machines so equipped.

The ALC is **automatic gain control**. The Nagra will adjust the volume of either Mic 1 or Mic 2 automatically.

I do not recommend using the ALC for anything other than surveillance applications. ALC tends to search for the optimum recording level of whatever the dominant sound is. It will aggressively ride gain on dialogue, which will make the backgrounds very distracting. When there is no speech, the ALC will raise the background noise trying to bring it up to the level of dialogue.

Headphone Jack and Headphone Volume Control

For best results when monitoring a Nagra, use a pair of high quality, closed-ear headphones such as the **Sony MDR7506** or V6, or the **Audio Technica ATH-M30**. Impedance of headphones should be between 35 and 75 ohm. **The Nagra headphone jack is monaural, so you will have to modify the plug on stereo headphones or use a mono adapter.**

Do not monitor with the headphone volume set too high, or fatigue and possible hearing damage may occur.

To find the ideal listening level, begin with your headphones around your neck but off of your ears. Depress the REF GEN button in the center of the Nagra to activate a -8 dB reference tone. Turn the headphone volume control all of the way down. Place the headphones over your ears and then gradually bring up the volume.

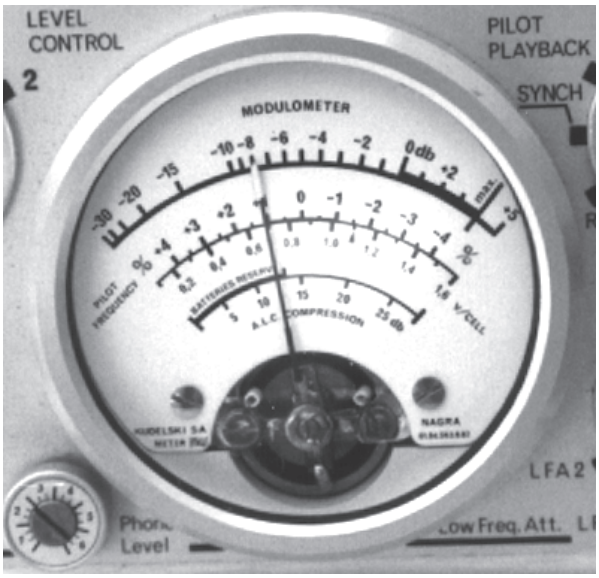
When the volume in your headphones reminds you of an uncomfortable telephone conversation (like someone chewing you out), the volume is correct.

The key word is **uncomfortable**, as in "move the telephone handset" a half-inch away from your head. Not painful, as in a heavy metal concert.

The level you have just set in your headphones represents loud conversation. (Remember, the -8dB setting on the Nagra is equal to 0 VU, which is pretty close to maximum volume for mag film or video.) Normal recording levels of regular dialogue should seem like a pleasant telephone chat with a friend. Not too loud, not too quiet. Recorded shouts and screams should be irritating, but not painful. Whispers should make you want to turn up the mic gain.

The ideal headphone level will vary from person to person due to differences in hearing and perception, so do not rely upon the volume setting that someone before you may have chosen. Similarly, do not rely upon the engraved numbers around the headphone volume control, since their value will vary from machine to machine.

If you are serious about working in the media, then make an investment and purchase your own pair of headphones. It is important to become consistent in your monitoring habits. Using the same pair of phones, at the same personal volume settings, is essential in being able to evaluate the quality of your sound.



The Meter

The audio meter on a Nagra is a **modulometer**, which is a **PEAK reading** meter. Unlike the common VU meters that measure the AVERAGE level of sound, the modulometer only concerns itself with the PEAK or loudest part of the sound.

It is sort of like the difference between an averaging light meter that reads middle gray compared to a spot meter that reads the highlights. The averaging meter guesses at the range the film can handle and provides an F-stop based on that assumption. The spot meter reads the brightest part of the scene and gives you a precise measurement.

In sound recording, we **need to be more concerned with peak levels** than averages, because it is the peak level that will distort if recorded too hot. The modulometer lets us know just how close to the edge of recorded distortion we can venture.

Think of it this way: the VU meter tells us **how far it is to the warning signs** and safety fence near the ravine, but the modulometer tells us **how far we are from the edge** itself!

Although a modulometer and a VU meter will react differently to pure tone than they will to dialogue, for the sake of simplicity **the industry settled on an 8 dB difference (tone)** when lining up the two types of meters.

Therefore, and this is important to memorize, a **meter value of -8 dB on a Nagra equates to 0 VU** on other recorders.

A reading of 0 dB on the Nagra would be nearly +10 VU on other recorders, which is a very hot signal!

When we transfer from the Nagra to mag film or video, we use a playback level of -8 dB on the Nagra to be rerecorded at 0 VU on the mag or video machine.

Conversely, if we connect a mixing panel or another recorder to the input of the Nagra, we will align 0 VU on the incoming source to -8 dB on the Nagra.

When you are recording dialogue, try to **keep normal conversation in the -8 dB to -6 dB range** (around 12 o'clock on the meter). Reserve the range near **0 dB only for extremely loud** shouts, screams, or chairs crashing through windows! If you record dialogue up near zero, it will be too hot (and distorted) after you transfer to mag or video.

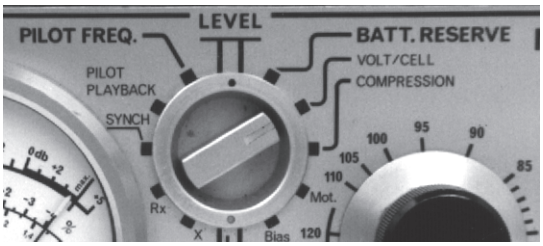
The exceptional recording and playback capabilities of the Nagra can be deceiving. Tracks that sound absolutely great on the Nagra may easily distort after being transferred to an inferior medium such as mag or video.

Audio on the Nagra will not distort until around +4 dB or higher on the modulometer. But you should never get that loud unless it is a momentary sound effect.

The meter on the Nagra can also provide other data to the operator besides audio level. These will be discussed later.

Meter Selector Switch

The meter selector switch is located to the upper right of the main meter. Think of it as a window to the workings of the machine.



Selecting any of the meter "views" does not affect anything being recorded nor played back. The switching process is silent and will not produce any pops or clicks on the track, so it is okay to play with this knob during recording.

The default position is **LEVEL**, which reads the audio level. During RECORD, the meter will read the incoming signal. During playback, the meter will read the signal off of the tape.

The **BATT RESERVE** position gives us a quick check on the condition of our batteries.

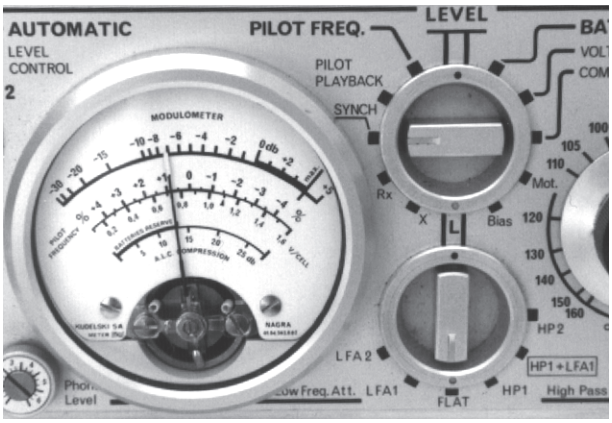
The **VOLT/CELL** position gives us an **accurate check** on the condition of our batteries, and is the best way to check your batteries.

COMPRESSION applies only to the ALC, which you should not be using anyway. I think only the service technicians have any use for this data.

MOT and **BIAS** are also for the service technicians.

PILOT FREQ is used in conjunction with the (optional) **QFM** frequency indicator circuit board that may or may not be in your Nagra. A deviation of up to plus or minus 4% is indicated comparing the pilot signal versus a 60 Hz crystal. In the old days, this was used to check the stability of camera fed sync pulse. I have used this position to check that the internal crystal is set to 60 Hz and not 50 Hz.

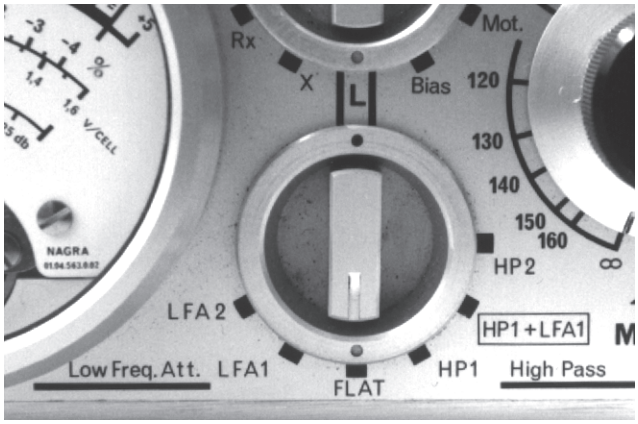
PILOT PLAYBACK measures the sync signal on the tape. Mainly for the techs.



SYNCH is a very useful position. When a tape is played back on the Nagra, and the Nagra is equipped with an internal resolver, this allows you to check the sync playback of your tape. When the resolver is engaged (Loudspeaker playback position only), you can check how well the Nagra is resolving the tape by watching the meter needle swing. If the needle remains steady and at 0 % deflection, then the tape is rock solid. Slight deflection indicates that the Nagra is adjusting speed to maintain sync. If the needle drifts and does not return, then there is no sync resolve.

Test your tape by slowing the reel with your thumb while watching the meter. Release the tension on the tape reel and watch how the needle bounces back, as well as listen to the audible wow as the resolver locks up. Compare this performance to one with the resolver OFF (use the first playback position).

RX and **X** positions are not currently used by the Nagra.



Filter Selector

Located to the lower right of the meter is the low frequency filter selector switch. This switch allows you some control in filtering out the lower frequencies (such as wind noise and rumble) during recording.

There are two types of filters, **LFA** (low frequency attenuation) and **HP** (high pass). The LFA have more of a gradual slope. The HP are steeper and more severe. Listen with your headphones to the subtle differences.

Most mixers just use two settings. **Flat is fine for interiors**. The **combination setting (HP1 + LFA1)** which is boxed is good for exteriors. By just using these two settings only, it is easy to achieve consistency throughout the entire shoot.

Input Pots

The three knobs in the center control the input level for Mic 1, Line, and Mic 2. Keep these pots closed if you are not using them to avoid hiss.

The Line pot controls the line level input from the ACC socket and the banana jacks. Do not use the ACC and the banana jacks at the same time!

A word of advice. When using a hissy mixing panel with the Nagra, it is quieter to raise the gain of the mixer by increasing the input level of the Nagra than by amplifying the mics or output at the mixer. Remember, mixer output lower and Nagra input higher.

Reference Generator

Located beneath the input pots is a small button labeled **REF GEN**. Depressing this button activates an internal tone generator that produces a **1000 Hz tone at -8dB** level.

This tone is used as a reference for lining up (adjusting the input levels) of various pieces of equipment, such as other recorders. Remember that a tone of -8dB coming out of the Nagra corresponds to a level of 0 VU on other recorders, such as a mag recorder or conventional reel-to-reel audio recorder. When transferring to digital, -8dB on the Nagra equates to approximately -20 on the digital meter. But the metering systems vary a lot depending on the digital device that you are using, so you may need to experiment to determine the best settings.

When you begin recording, a **head tone** of at least thirty seconds duration should be recorded at the head (front) of every reel of fresh tape. While recording this head tone, monitor off of the TAPE position so as to check the quality of the recorded signal. The tone should remain steady as you listen in the headphones. Major fluctuations in level are indicative of dropouts on the tape, which probably means that the tape stock is defective.

Every time I open up a fresh case (20 reels) of tape for a production, I record and listen to one full minute of head tone in order to quality check that particular emulsion batch. The presence of a dropout problem on one reel of a batch leads me to suspect the rest of the batch. If I cannot replace the entire carton, then I do a full minute check of every "suspect" tape roll.

During playback transfer, the playback level of the Nagra should be set so that the -8 dB head tone on the tape plays back at -8 dB on the Nagra, and is rerecorded at 0 VU on the mag or other recorder.

The REF GEN is also used to **mark the end of every recorded take**. After the Director calls to "Cut!", the mixer should wait another second or so (the editors appreciate the extra tail length to work with in case of fade-outs), and then depress the tone generator twice to mark the end of the take.

The presence of the two beeps makes it easy to delineate between takes when fast forwarding or rewinding. (I have been known to record series of beeps to indicate the take number on sequences of very short takes. e.g. one beep, two beeps, three beeps, four beeps, five beeps.)

However, two beeps after a take is the norm for studio production. Note that while two audio beeps denotes the end of the take on the Nagra, two blasts of the stage bell indicates a "cut" when using a "flashing red light and bell" soundstage warning system.

Tape/Direct (Line & Phones)

This switches both the headphone feed as well as the line output between **DIRECT** and **TAPE**. Direct means monitoring the signal as it enters the Nagra system. TAPE refers to monitoring off of the just recorded audiotape itself. This is possible because the record head is before the playback head, so the operator is able to literally “play back” the tape moments after it has been recorded.

Monitoring off of **TAPE** is useful for verifying that a clean signal has indeed been recorded. Just because an incoming signal makes it into the Nagra is no guarantee that the sound has been recorded. Listening to TAPE allows you to make sure that you actually have something on the tape!

The drawback to monitoring off of TAPE is that the audio heard in the headphones is slightly delayed, meaning that what you are hearing has already occurred in the past. **This also means that you may be reacting (mixing) to something that has already happened.**

For this reason, most professional mixers will **listen off of TAPE during the clapstick** of the scene to verify that their Nagra is working, but during the scene itself they monitor off of DIRECT so as not to be a beat behind reality. During a long (technically boring) take, a mixer may flip in and out of TAPE briefly just to check on things.

Expect to hear much more in the headphones in DIRECT than in TAPE, since the range of the incoming signal is not subject to the signal-to-noise limitations of a signal already on the tape.

There is **one professional exception** to the rule of not monitoring the entire take in TAPE. If there is a chance of extremely loud, sudden noise such as a crash, explosion, or gunshot, monitoring off of TAPE will protect your eardrums. There is a physical limitation to how loud a signal can be played back from tape, and that is a lot lower in volume than the actual sound. That is why gunshots shown on the nightly news end up sounding like mild caps instead of the deafening roar of a real firearm.

Remember, accidents on the set are not scripted nor planned. But the potential for accidents can be obvious, and all precautions taken. I personally know of two Hollywood mixers who lost their eardrums because their super sensitive mics amplified accidental gunshots that were not supposed to take place until later in the schedule. A sincere “sorry” from the Assistant Director did not make up for their hearing damage!

The TAPE/DIRECT switch also plays a special role during playback. In the tape position, the Nagra will playback audio at a factory set, fixed output level. In the DIRECT position, the output level of the Nagra can be user controlled by means of the middle (Line Input) pot on the face of the machine.

Tape/Direct Meter

Directly beneath the headphone Tape/Direct switch is a spring loaded toggle for Tape or Direct reading on the meter. Normally during record, the meter always indicates the incoming or Direct signal.

But if you wanted to meter off of the tape, you could hold this switch on TAPE. Personally, I can’t think of a situation where you would want to.

Power

As previously discussed, this switch indicates whether the Nagra is taking its power from internal batteries or external powerpack, such as the ATN mains power supply.

In the real world, this switch is used as a **master ON/OFF** control. External, when there is no external power present, serves as the power OFF setting.

Main Function Selector

When the main function switch is pointing to the **nine o'clock position, the Nagra is OFF**.

The **TEST** position activates all electronics except for the record circuitry. All meters and mic preamps are active. This is the usual rehearse or preview mode.

The next two positions are for RECORD.

The first **RECORD** position stands for RECORD WITH LIMITER. There is an excellent audio limiter built into the Nagra that will prevent you from accidentally over modulating (i.e. "recording way too hot"). This limiter does not kick in until around +4 dB, so it should not affect normal recording levels (if your are anywhere near +4 dB, you are way too hot!).

The second record position is **RECORD NO LIMITER**. It is preferable to record without the limiter on loud sound effects such as gunshots, since the distortion is part of the sound that audiences expect. Also, there will be a slight recovery time after the limiter releases its hold on the audio, and that may affect backgrounds on the soundtrack. The effect of the limiter on backgrounds may be more distracting than an occasional and very brief shout or utterance that blows out on account of too much volume.

There are two **PLAYBACK** positions on the Nagra. The first PLAYBACK mode is used for non-sync playback in the headphones or line out. The internal loudspeaker does not function in this mode. The **internal resolver does not function** is this mode. This playback mode is used for private quick checks of the audio by the operator, or for locating cue points for playback.

The second playback position is **PLAYBACK LOUDSPEAKER**. The speaker in the Nagra is now functional (if you do not want it on, just adjust the speaker volume control on the left side of the machine all the way off). **The internal resolver is automatically activated in this playback mode, providing that there is one installed in your machine.** (Not all Nagras come equipped with resolvers, since they are not needed for sync recording.)

Fast Forward is only available in the **PLAYBACK LOUDSPEAKER** mode.

Pilot Indicator Flag

When this dial turns white, it indicates the presence of an incoming sync signal. This signal can come either from the internal crystal sync generator or from an external source such as a camera.

This flag will function in the **TEST** as well as **RECORD** modes. Flickering or complete loss of the white flag indicates a bad sync signal, and lip sync has probably been lost.

If there is a problem with your sync, **check the crystal jumper plug** on the right side of the machine. It may have come loose and needs to be tightened. Or it may have fallen off and needs to be replaced.

Speed & Power Indicator

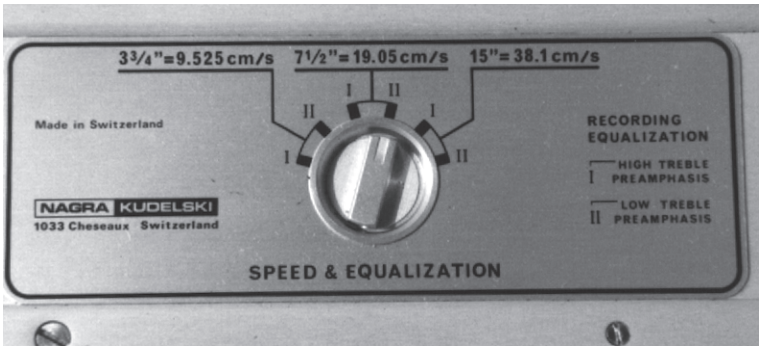
This flag should come on and remain steady during RECORD. If this flag flickers or goes out, you have lost lip sync.

The usual cause for loss of speed & power is low batteries! Check your volts per cell on the meter. Change them if the reading is below 1.2 volts.

If the batteries were not your problem, then cease using the Nagra until a trained service tech can check it out.

Transport Deck of the Nagra

Speed and Equalization Switch



Located between the tape reels, this switch controls the tape speed and bias type. **The normal tape speed in our industry is 7 1/2 inches per second.**

The **slow speed of 3 3/4** is usually for surveillance (or some documentary) and results in longer record time per tape reel but at reduced audio quality. The **higher speed of 15 ips** yields a shorter record time per reel, but improved audio quality.

However, before using the other speed settings, make sure that your Nagra has been calibrated for optimum performance at the slower or faster speeds. Many machines are only set up (economy maintenance) for use at the 7 1/2 ips setting.

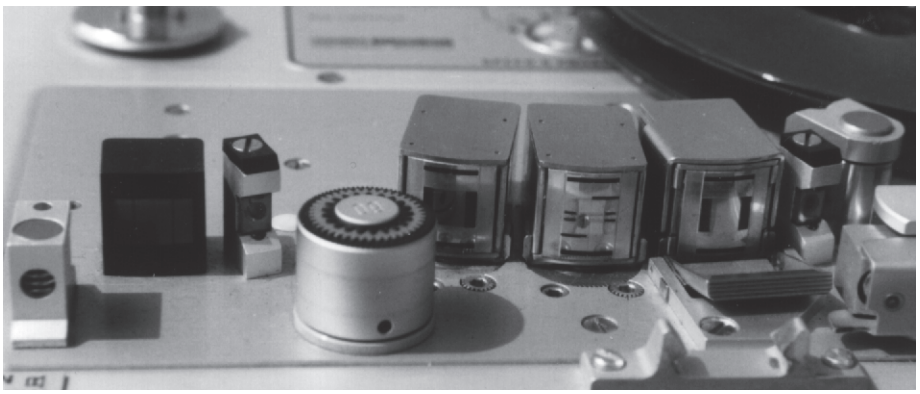
There are two bias settings available for each speed: **LN** and **STD**. LN refers to low noise, high output and is the normal setting for today's tape stocks. Some machines have been calibrated so that both STD and LN are actually LN.

A brief word about tape stocks. Some companies, such as 3M and Zonal, have stopped manufacturing 1/4-inch reel to reel audiotape. Ampex sold their line to Quantegy. BASF also produces professional audiotape. But there are differences in the bias settings for these tapes, so make sure that you use only the correct brand and stock number of tape that your Nagra has been set up for. We use Quantegy 406 and 408 tapes on our machines, but many folks like the BASF 468. *By the time you read this, other audiotape may be standard.*

A five-inch reel of tape (600 ft) will run for 15 minutes at 7 1/2 ips. Some tape reels offer 900 ft on a five-inch reel, so the stock is thinner and a five-inch reel will run for 22 1/2 minutes. However, the thinner stock is subject to more noise (print-thru) so it should not be your first choice unless documentary conditions require a longer record time.

A seven-inch reel (1200 ft) will run for 30 minutes at 7 1/2 ips and is the standard for professional feature and TV applications. A seven inch reel of thinner stock will run for 45 minutes, but be wary of print-thru).

Seven inch reels will fit on the Nagra with the plastic lid cover kept open. Nagra offers an oversize plastic reel cover that will accommodate seven inch reels; virtually all machines in Hollywood are so equipped. When using the seven inch reel cover, be careful that the back edge of the cover does not press up against the reels (there is very little margin of clearance and even slight forward pressure can cause a problem). A Hollywood trick is to remount the lid on the rear hinges so that the hinge itself is inside the lid and the retaining bar is outside; the lid is now forced rearward and away from the tape reels.



Head Stack

There are four audio heads on the Nagra: **ERASE, RECORD, PILOT, and PLAYBACK**.

The **ERASE** head is on the left, situated in between the tension roller and the stabilizer roller (strobe wheel). The ERASE head looks like a black cube. It erases the entire width of the tape (anything and everything!).

Centered on the transport deck are the three main tape heads. The left head is the **RECORD** head, and this head records full track audio.

The center head is the **PILOT** head. During record, this head records two sync tracks down the center of the tape (each sync track is exactly out of phase with the other, so that they cancel each other out when played across a full width playback head).

On the right is the **PLAYBACK** head. This is a full track head and will not hear the twin sync tracks. Newer machines are equipped with a hinged, playback head shield that guards the playback head from stray radio interference. When threading the Nagra, make sure that the tape goes in between the shield and the head itself, and then simply close the shield over the tape.

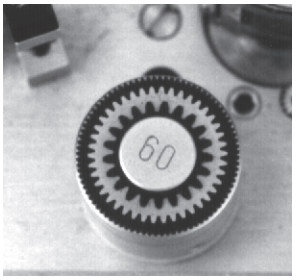
Nagra heads and all metal rollers/guides along the tape path should be **demagnetized periodically** (before any major shoot). Ask a technician to show you how to do it if you are not familiar with demagnetizing heads.

Heads and everything along the tape path should be gently CLEANED (wiped) at the beginning of every shooting day (or as frequently as flying dust conditions warrant). It is okay to **use common 70% isopropyl rubbing alcohol** even though denatured alcohol is technically better. If you use the isopropyl, allow several seconds for the alcohol to fully dry before threading your tape. Try to use a **lint free** piece of very soft cloth or a foam tipped video cleaning swab rather than loose cotton "ear" swabs.

A number of professional sound mixers use the **pre-moistened alcohol pads** that the medical profession uses for sterilizing injection sites. These pads are sold nonprescription in drug stores over-the-counter, and only cost a couple of dollars per box of 100 individually wrapped packets.

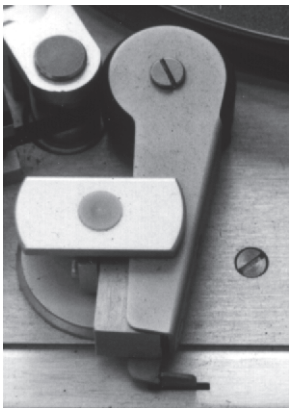
The **pads are more convenient** than carrying around a bottle of alcohol. The pads can also be used for cleaning your headphones, brightening connectors, prepping the skin prior to rigging a lavalier, and for first-aid.

Tension Rollers



Located just in front of either tape reel are the two tension rollers. The tape threading path goes around the outside of either roller. During RECORD or PLAYBACK, these rollers should settle down and cease wobbling after only a moment. If the rollers continue to vacillate more than a second, your Nagra probably requires adjustment.

Stabilizer Roller



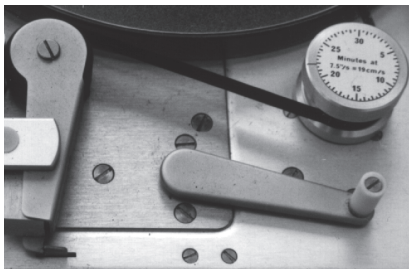
Just to the right of the erase head is the stabilizer roller. On the top of this roller are strobe wheel markings marked 60 Hz. When the Nagra is running, if you view this strobe wheel under a household AC lightbulb and squint kind of funny, the marks will appear to hold steady if the Nagra is running true to speed. A slow drift of the strobe markings indicates that the machine is running fast or slow and may be an indication to have the machine checked.

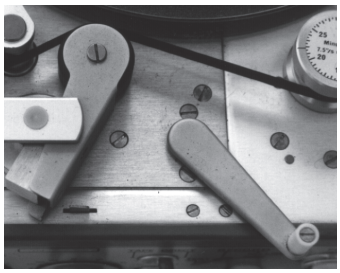
Any time that I use a Nagra that has just completed a long journey to the location, I do a quick strobe test in my hotel room.

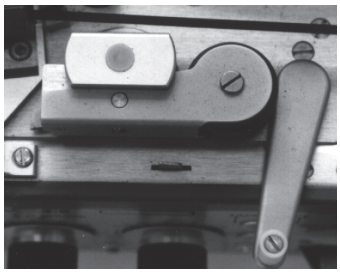
Pinch Wheel Lever

The pinch wheel lever provides tension and holds the tape between the spinning metal capstan and the rubber roller pinch wheel. When the Nagra is at rest, the pinch wheel is slightly away from the capstan.

Tape motion can be halted or paused by "pinching" this lever with your fingertips. Releasing the pinch lever will result in an "instant start" of the tape. This feature is useful for searching cue points.







Three Position "Clutch" Lever

This lever controls the pinch wheel and has three positions.

The lever should be pushed all of the way in for forward tape motion.

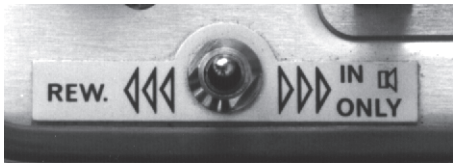
When the lever is pulled outward all the way to the left, the tape can be threaded. Rewind is possible in this position by activating the REWIND switch.

The mid-position "rides the clutch" and will prevent the tape from moving.

If you need to PANIC STOP during forward motion, it is better and easier to simply squeeze the pinch lever than to jerk this clutch lever.

When this lever is pressed all the way in, there should not be any noticeable slack or play of the lever. So if the lever exhibits some freeplay before "engaging", the set screw on the inside of the deck needs to be tightened. Ask a service tech to do it or to show you how.

Rewind/Fast Forward Switch



To rewind a tape on the Nagra, pull the clutch lever all of the way to the left and then flip this switch to rewind. To slow down the rewind process, just toggle the rewind switch between rewind and neutral (off).

To fast forward, the Nagra must be in LOUDSPEAKER PLAYBACK. To slow down, toggle between fast forward and neutral. To panic stop, just squeeze the pinch lever.

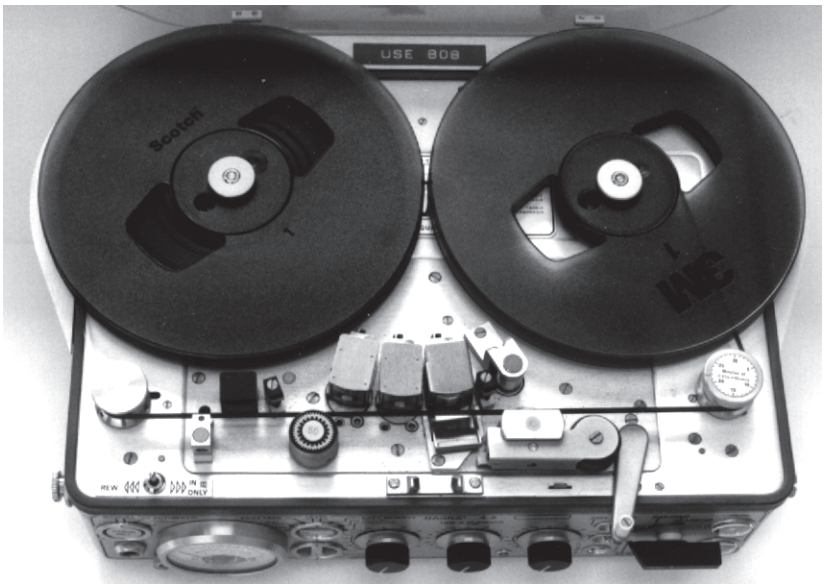
Do not rewind the tape when you are finished recording a reel. Turn in your tapes TAILS OUT (which should be marked on the reel box) and let the transfer people do the rewinding on their heavy duty studio machines.

General Notes on Threading the Nagra

Unscrew the reel lock nuts and store them on the clutch lever so they won't get lost. Nagra reel nuts are a special thread and very expensive to replace!

Open the clutch lever all of the way.

The supply reel of tape goes on the left, and an empty take-up reel goes on the right. The tape path is U-shaped: from the outside edge of the supply reel, the tape runs along the outside edge of the Nagra and then along the outside of the tension roller, then straight across between the tape guides and audio heads, around the outside of the other tension roller, and up along the outside edge of the Nagra to the take-up reel, where the tape is taken up in a counterclockwise direction.



Hold the tape in the tape slot of the take-up reel, or lick the end of the tape emulsion to make it stick against the hub of the reel. Cut off any excess tape that may be protruding from the tape slot. Wind the take-up reel several turns with your finger.

Close the clutch lever and replace the reel nuts.

If your Nagra is equipped with a playback shield, make sure that the tape is threaded between the shield and the head, then close the shield over the tape.

Voice Slate Your Tape

After your tape has been threaded properly on the Nagra, you should put a verbal head slate announcement on the tape containing pertinent information for future reference.

“Roll number...
“Production number/working title...
“Production company/studio...
“Date...
"The following is a -8 dB headtone recorded at 7 1/2 ips on the Nagra 4.2 with a 60 Hz sync pulse."
(followed by 30 seconds of continuous reference tone) *While recording the tone, you should switch your monitor to the TAPE position, so you can listen to the tone as it was recorded, in order to detect tape drop-outs.*
(beep, beep to indicate end of headtone)

Pre-slate your take numbers

To conserve expensive motion picture film, we do not read the slate aloud on camera prior to hitting the clapsticks.

Record the scene and take number of the upcoming take as "wild sound" (no camera running) ahead of time. Most professional mixers voice slate the take in between turning the Nagra on after the command "roll sound" and their responding with "speed".

For instance...

The Assistant Director calls to **"put us on the light & bell, please"**. The Sound Mixer activates the red light and bell system (one long blast of the bell or buzzer to warn everyone to cease making noise).

Then the A.D. will shout to **"roll sound"**. The Mixer turns on the Nagra and announces into the slate mic **"Scene 101 baker, take 4"** or whatever. Note that letters are announced as words (alpha, baker, charley, david, edward, frank, etc.) so as to eliminate confusion. You can make up your own words, it does not have to conform to military standard.

After the voice slate, the Mixer responds with **"speed"**. By that time, the Nagra should have stabilized.

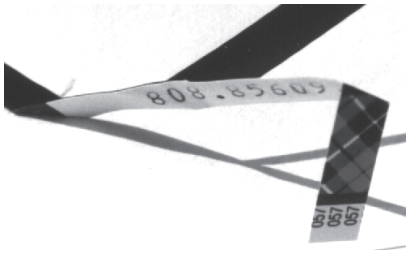
The A.D. will then call for **"camera"**. Since the camera comes up to speed almost immediately, the camera operator will call out **"mark it"** to the clapstick holder.

The clapper person calls out **"marker"** and strikes the sticks. In the event that camera or sound did not record the clapstick, they would shout for **"second stix"**.

Then the Director would call for **"action"**.

Log Your Data

Always **note the serial number of your Nagra** on the audio log sheets. In case of some sound problems (such as crystal frequency error or head alignment error), you may need to transfer the tape off of the same machine it was originally recorded on.



When you open a fresh roll of audiotape, you will note that there is a colorful, sticky tab on the beginning of the tape holding it closed. Cut off this adhesive endpiece and affix it to the inside of the tape box, or put it carefully with your production notes.

This endpiece contains the emulsion batch number of the tape stock you are using. In the event of dropouts, you will want to know what tape batch is of questionable quality. Avoid using any more tape from that batch number, or at least check the tape carefully for the presence of dropout.

You can do this by recording at least a full minute of reference tone on the tape while monitoring in the TAPE position (so the tone you hear in your headphones is coming off of the just recorded tape). If in doubt, don't use the reel! Return it for refund or exchange.

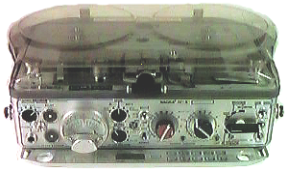
Conclusion

The Nagra 4.2 recorder is a remarkable piece of engineering that has withstood decades of professional application in the realm of motion picture production. Consider the quality and speed accuracy that this very portable recorder offers. Realize that it is almost maintenance free (compared to studio recorders), and that it can continue to function under the most adverse environmental conditions.

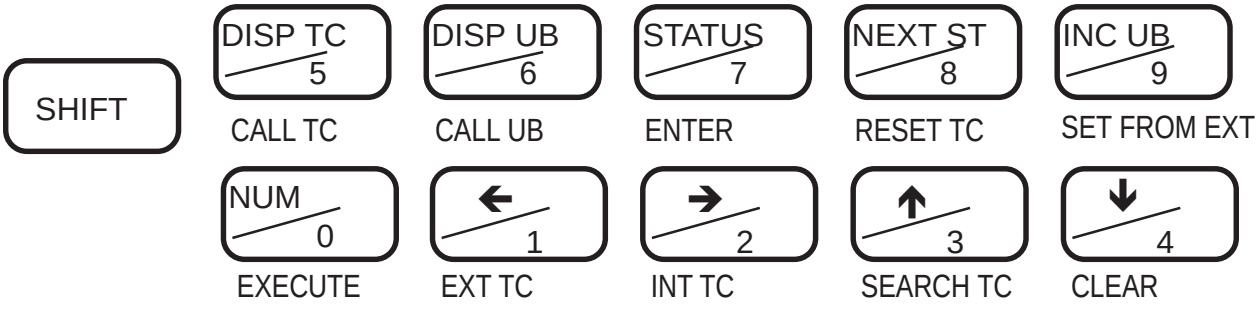
Use the Nagra the way it was intended. Read these instructions carefully. Practice with the machine to become familiar with it. You will discover that the Nagra is not as complicated to operate as it looks, but proper operation is something that you need to take the time to learn.

Don't be afraid to ASK QUESTIONS. No matter how dumb you think you're question might be, it's far better to ask it than to risk jeopardizing a project (and your professional future) by making a critical error on a shoot.

Special thanks to all of the folks at **Nagra** for all of their support in the development of this instructional guide.



Simple Instructions for programming the Nagra IV-STC to time of day and date (User Bits)



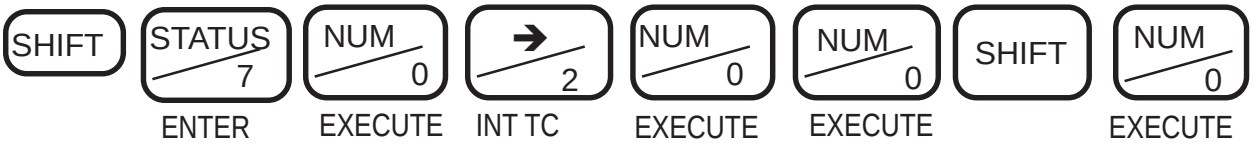
To check timecode status, press **STATUS**. There should *NOT* be any marker under where "**Drop Frame**" is engraved on the display. Presence of a marker indicates Drop Frame Timecode, which is not what is normally used for film. Press **NEXT ST**atus to check frame rate (should read "**30 Fr**").

To reset frame rate and/or drop/non-drop frame, turn function switch to **STOP**. Open deck and set frame selector knob to desired frame rate. **30 fps NDF** (non-drop frame) is the industry standard for film cameras running 24 fps or 30 fps. *Do not use other settings without WRITTEN INSTRUCTIONS from your production company, or they may complain to you later when they can't get stuff to sync!*

Turn Nagra function switch back to **TEST** and repeat **STATUS** and **NEXT ST**atus check to verify settings.

To clear machine of previous programming: **SHIFT**, **ENTER**, **0200 SHIFT**, **EXECUTE.**

Example...



To program the user bits for use in the date format, press **0106**, **SHIFT**, **EXECUTE**.

To enter the time of day, press **50** (**HOUR**, **HOUR**, **MINUTE**, **MINUTE**), **0000**, **SHIFT**, **ENTER**.

To enter the date, press **60** (**DAY**, **DAY**, **MONTH**, **MONTH**, **YEAR**, **YEAR**), **00**, **SHIFT**, **ENTER**. To display the new Time Code, press **5**.

To program the Nagra for RECORD RUN timecode (code advances only during Record), press **SHIFT**, **ENTER**, **0100**, **SHIFT**, **EXECUTE**. Note that this feature is only available on machines with software Version 1.95 or above. To check software version, press **STATUS**, and then repeat pressing **NEXT ST**atus. To return machine to regular timecode mode, follow the above instructions for CLEARING the machine and then setting time of day.

THE SOUNDTRACK

Before we get started...

This text is about the craft of Production Sound recording for motion pictures and videotape. Production Sound Mixing is the craft of recording dialogue and sound effects on the set during principal production. Whether you aspire to specialize in sound mixing; or just seek to enhance your skills in order to occasionally fill in as "soundperson" on a small shoot—the material in this book will prove invaluable.

There are also, no doubt, a number of readers who have absolutely no interest in the world at all about doing sound. You may have aspirations to Direct, Produce, D.P. (director of photography), Edit, or Whatever. For those of you, I suggest that you need the information contained within these pages even more than the future sound mixers—for they, at least, will eventually learn through trial & error, if nothing else. You, on the other hand, may never have to personally record sound, but much of what you do in your specialty will hinge directly upon the success or failure of the sound crew. Learn as much as you can about each other's crafts, because a little understanding and compromise may make a major difference in the final product.

On the same token, prospective sound mixers should also endeavor to learn as much about all aspects of filmmaking as possible, for the same reasons. Much of what you do affects the rest of the production, in terms of time, budget, and quality. Learn Editing and Lighting, especially!

You live or die in the dailies

In Hollywood, we have a saying, "You live or die in the dailies!" Because that is when the producer evaluates the performance of the entire crew.

In the real world, where time is money, no one is going to wait until the first cut (six weeks after the end of production) to make a decision. Technicians and even Directors will be gone before their next pay check if their work doesn't shine in that screening room! A Sound Mixer whose tracks are consistently unusable, whose material always sounds like it will need a lot of sweetening or fixing up later—is not going to be kept around! Ditto, a Director—especially a young, new Director—will be replaced early on if it appears that he or she always seems to need additional, costly takes because they can't relate to their crews!

But the Director who only shoots one or two takes, and consistently delivers good footage from his actors and technical people is definitely going to be favored by the producers.

There are no apologies, no excuses. What gets projected up on that screen, and heard through those speakers, had better be top notch.

An anecdote...

One side note, if I may. After I left college, I envisioned myself as a cameraman. I had the necessary skills, including professional still photographic as well as cinematographic experience. Actually, I figured that no one would hire me outright as a Director of Photography, so I planned on starting as an Assistant Cameraman (focus puller). After coming out to Hollywood, I took immediate employment at a motion picture equipment Sales/Rental house, and also began freelancing on the side.

On one particular shoot, the Producer was desperate for a soundman, so I "switched hats" and took over the Nagra. That same producer hired me again several times—as his Sound Mixer!

Soon, I found that I could work a lot steadier and advance quicker mixing sound than by loading magazines & checking focus. Photography became a hobby again, and I became a full fledged Sound Mixer. The moral is, life may surprise you. Learn it all, for everything you learn about filmmaking will come in handy one day or another.

WHY DO YOU THINK THEY CALL THEM "TALKING PICTURES"?

If audiences didn't care about dialogue, but only were interested in the visuals—Hollywood never would have bothered to invent sound motion pictures. But early movie goers did care, and thus the soundtrack was born.

How did Hollywood refer to this new marvel of modern technology? They didn't hype the sound effects. Audiences already heard "live" sound effects, courtesy of men performing theatrics in the orchestra pit. The studios didn't hype the music, films already were projected with orchestral accompaniment. The big attraction was DIALOGUE. For the first time, audiences could hear the movie stars speak!

Hence, when 'silent' motion pictures were supplied with the first sync soundtracks—everyone named them the "talkies". Production Dialogue had come to movie making!

From those early days of sound onward, filmmakers have relied heavily on the presence of sound to help tell their stories or convey their messages. They discovered that picture and sound were two sides of the same coin.

Picture and sound could reinforce each other—that is, cover the same material, or contribute to the same perceived message. We see an airplane; we hear the airplane. We see an actor shout; we hear the shout.

On the other hand, picture and sound could counterpoint each other. This refers to the soundtrack conveying new or different information and meaning than a viewer could perceive by only seeing the visual. We see the airplane; but we hear a hijacker's threat to the pilot. We see an actor shout; but the music tells us that he is joyful, not angry.

In any case, sound has unquestionably become an indispensable aspect of modern filmmaking (and television).

If you doubt this for even a moment, try this simple exercise. Turn on the television to any show. Watch for a few moments, and then turn your back to the screen. The soundtrack alone will supply you with enough details to keep track of the story. Now, try the same thing with the picture—that is, watch the screen but turn off the sound. The storyline becomes much more difficult to follow.

The point is—even though all of the glory in filmmaking is associated with camera work—without the sound, those pretty pictures lose a lot!

It is sort of ironic, but that conclusion is often a whole lot more apparent to audiences than to filmmakers on the set. Everyone is willing to sacrifice all on behalf of getting a good shot, but rarely do amateur and low budget filmmakers concern themselves seriously with sound. Directors often take audio for granted, until they get back to the editing room. There, they regretfully discover how much better and easier it would have been had they spent the effort to record good sound on the set while they had the chance.

ELEMENTS OF THE SOUNDTRACK

Much of what a Production Mixer does is based upon his or her assessment of what will be needed later on during post-production (editing & final mixdown). With that in mind, let's begin with a brief overview of "post" and work our way back to the production side of things.

What types of sound make up a motion picture or video soundtrack?

Narration

Many films rely heavily on NARRATION to hold the visuals together or to provide explanation. All of us, I'm sure, are familiar with documentaries, travelogues, and educational films that employ Narration as the primary element of the soundtrack. Don't forget, however, that many theatrical films also use Narration as a story device—sometimes in the role of an 'anonymous' storyteller, sometimes as the inner thoughts of a principal character.

Narration can be recorded in two different ways.

The first way, or style, is to have the narrator view the film and record live commentary while it is projected. The lines may be from a script or totally improvised, depending on the film in question. This style is referred to as "sync to picture". As you have guessed, it is quite common to travelogues! The other approach, which is usually the preferred way of doing it, involves recording the narration "wild" from a script, instead of from watching the picture. The talent reads the lines from a prepared script, which are recorded as isolated takes. (Note, while it is true that some narrators may view the film in preparation of the recording session, the picture does not play a role during the session itself.) An editor then cuts the desired lines in place opposite the appropriate footage.

This method gives the filmmaker maximum creative control over the relationship between picture and narration, and allows greater flexibility should editorial changes be desired later on. It also frees the narrator to concentrate on enunciation and delivery of the lines, rather than worrying about matching whatever is up on screen that moment.

Narration tracks can physically be recorded either in a professional recording studio (with full acoustic isolation from any outside noise), or as a "wild track" while on location. Which technique is used depends on knowing how the narration is to intercut with the rest of the soundtrack.

If the narration is supposed to be authoritative and 'anonymous' (commonly nicknamed the "voice of God" approach) — then isolated studio recording is called for. The voice track is recorded with a full presence, completely free of any ambient background noise or room coloration (room echo or bounce).

On the other hand, if the narration is supposed to be a "continuation" of on-screen dialogue or on-screen explanation—then the narration is usually recorded as a "wild track" (camera is not shooting) at the same location. The sound quality of the wild lines should match closely with the sound quality of the original on-screen portion of the dialogue. Perspective and presence should be similar. Background ambiance and room acoustics should also match. The goal is to convince the audience that the narration is an uninterrupted continuation of the talking head they saw at the beginning, even though the visuals have cut away to instructional inserts.

It is true, however, that often the sound mixer will be asked to record "voice of God" narration as well as "wild lines" while out on location, due to limited availability of some actors (or limitations of the budget). This, though, becomes more a matter of technique in "faking it" (to sound like an isolated recording studio).

Music

Even the earliest 'silent' films depended heavily on music to add emotion to moving images. The presence of a musical score tells the audience what feelings they are supposed to have: joy, sorrow, tension, exhilaration, impending fear, etc. In fact, many prerecorded musical scores in music libraries are titled and catalogued by their suggested emotional effect.

If this explanation of music's role is new for you, then experiment a little. View a favorite film or two on videocassette. Pick out a few major scenes, and try viewing them again with the sound off. Instead, play a few music albums in the background as you view the scenes. Notice how each different music selection appears the change the feeling of the scene!

As you can see, the presence of music always has some effect on what the audience will perceive about a scene. Depending on the musical selection, this effect may reinforce, contradict, or completely alter the original intent of the picture.

The dramatic source of music under a scene can be either "extraneous" or "practical". Extraneous means that the score is simply there on the soundtrack because the filmmaker put it there to accompany the picture. The people in the movie theater hear it, but the characters in the film do not. Most music in soundtracks falls under this category.

In contrast to this, some music is initially explained or motivated by some source on screen, such as a radio playing, a nightclub band, or a character musician. In these instances, the music that the audience hears is also being heard by the characters on screen!

Sometimes, music can creatively overlap both of these categories, by starting off as extraneous and then being revealed as practical, or vice versa.

Music for a soundtrack can originate one of two ways: canned or original score.

"Canned" music refers to having come from a prerecorded music library. For a fee, a producer can purchase the rights to use selections of existing music in his or her production. A large number of companies produce volumes of high quality, generic purpose music tracks intended exclusively for this purpose. The music is composed and recorded so as to facilitate "modular" editing to accommodate scene length or climax.

Producers can pay for the music on a "needle drop", screen minute, or blanket basis. Needle drop refers to buying music based on a per selection, per use, basis. Blanket arrangements permit unlimited usage of the entire library either per entire production or per entire year. In determining their fees, music libraries will also want to know the intended purpose and scope of distribution of the film (theatrical, educational, home video, nationwide broadcast, industrial in-house, etc.).

Readers are warned, however, to exercise extreme caution in planning to use consumer music albums (pop, rock, soul, oldie, classical, etc.) as sources of music. Even in cases where the song itself is in public domain, the particular arrangement and performance are protected under copyright and fair trade laws. If you feel it is absolutely imperative to use a "real" song instead of one from a music library, make certain to obtain permission—in writing, in advance—from the recording company in question! Otherwise, you will discover just how ruthless, greedy, and unsympathetic lawyers and their clients can be.

The other source of music is to have it originally composed and recorded for your project. This could involve a full scale orchestra, or be as simple as a single musician overdubbing himself. The process begins with supplying the composer with a videotape copy of the footage along with instructions from the director or editor.

In the course of composing the music, at some point the composer and editor will create what is known as a "click track". This is a soundtrack that consists solely of clicks placed opposite the picture in order to convey cutting rhythm and climax. This click track serves to guide the composer and, later on, the musicians in keeping 'beat' with the film rather than a more arbitrary reference rhythm.

After the music has been composed, the next step is obviously to record it. In the case of an orchestral score, musicians are assembled and arranged in a large recording studio, known as a "scoring stage". There, they view the film on a large screen while hearing the click track in headphones. Led by the composer, the orchestra performs the selections. The music is recorded on multi-track for later mixdown.

When the score is composed and performed by a single musician, as is more often the case on low budget productions, the individual composer may be responsible for producing the entire musical soundtrack. Employing a portable multi-track recording system in conjunction with video playback, he or she will commonly perform and overdub with keyboards, synthesizers, electronic drums, and perhaps a few acoustic instruments.

As to which form of music is better, it all depends on the situation, budget, and talent pool available. A good canned library will sound better than the results obtained from most "aspiring" young composer/musicians and from many "hack" orchestral composers. On the other hand, there are many talented composers whose quality and brilliance far surpass the generic accompaniment of even the best music libraries. (Personally, on low budget shows, unless the individual is of known and proven aptitude—I would prefer to go with a canned selection of good quality rather than gamble for excellence and end up with trash.)

There is also a new form of music library that utilizes computerized software to custom create a music score from pre-recorded songs assembled from modules. After the film editor selects a genre and length (within 1/10 of a second), the program will search its library for appropriate title selections. Music is created by assembling appropriate modules (opens, endings, middles, etc.) to achieve the correct length. Variations of the theme are created by assembling different modules in different order. These computer assisted music libraries are a fantastic compromise between custom music and traditional pre-recorded offerings.

Sound Effects

The third of our soundtrack elements, in addition to narration and music, is the category of "Sound Effects".

Sound Effects (commonly abbreviated as "FX") refer to the sounds—other than dialogue—that objects or people make, along with those sounds that occur naturally in the background. All of these sounds are defined as "natural" necessarily only within the creative context of the movie and the filmmaker's imagination. What they may or may not sound like in real life is not always in question. Who really knows what a three foot mosquito sounds like, so long as the sound effect works within the creative framework of the movie!

Sound effects can refer to events happening on or off screen. Footsteps of an actor may be an on screen event if we see the actor. Footsteps of the killer, coming down the hallway, outside of the closed door are an off screen event if all the audience sees is a shot of the closed door (from inside of the heroine's room). Similarly, background ambiance often refers to off screen activity that the audience may never see, such as a passing siren, birds & crickets, a thunderstorm, and so on.

Sound effects may be either frame-accurate or wild. If the effect is dependent on synchronizing exactly, frame-to-frame, with an on screen event — it is known as a frame-accurate effect or more commonly, a "hard" effect. Examples include matching the sound of a gunshot with the firing of a gun, matching up door slams, whip cracks, sword clashes, punches, silverware being put on a plate, and so on.

If the sound of the effect only needs to be placed in the vicinity of an on screen event, but specific frame-to-frame synchronization is not important, then it is referred to as a wild or "soft" effect. Examples include environmental backgrounds (birds & crickets, rain, wind, ocean surf, traffic), engine noise, cafeteria ambiance, crowd noises, applause, laughter, even music and narration.

The sound effects themselves can originate from a number of different sources. Many effects are lifted from special sound effects libraries that operate similarly to music libraries. Editors can pay per effect, or arrange blanket usage agreements. Most sound editors and studios maintain and compile their own elaborate libraries of sound effects, built up over the years from all of the films they have worked on as well as by swapping with fellow editors. Unlike music, it is very difficult to identify original ownership of most sound effects—so, except in a few rare cases (recognizable synthesized effects), mere access to an effect is considered by most editors as an okay to use them. Legally speaking, that is false. However, the practice remains rampant in Hollywood.

Library effects include both "hard" effects as well as "wild" or "soft" backgrounds.

Sound effects don't always come from a library. Quite often, they are recorded right on the set during actual production. Effects may be recorded in "sync" with picture during a take. This might include footsteps, door slams, explosions, car crashes, virtually anything that takes place in front of the camera.

Sometimes, though, these sound effects coincide with live dialogue or other effects. In those instances, and when time permits, the location sound mixer will try to record the sound effect "clean" after the take has been shot. (Although it can be confusing, the term "wild" also applies to anything recorded on the set without the camera rolling in sync.) This newly recorded effect retains most, if not all, of the same ambiance and characteristics of the original take. It is also completely accurate in that the same props were utilized.

Imagine yourself as an editor trying to match the sound of an arthritic woman slamming the car door of a '62 Thunderbird coupe... from an effects library. There might be a dozen or so car door slams, but probably none with the right speed, intensity, delivery—not to mention car model. In some situations, exact matching of details may be very critical, such as in a sales film or commercial, where it is illegal to substitute the sound of another car for the one being featured.

Sound effects can be recorded after production, during editing. It is not uncommon for a sound editor to send someone out (hopefully, a bona fide soundperson) in order to record a list of needed effects. Freshly recorded sound effects are usually far superior to anything in a library. By knowing as much as possible how the effect is to be utilized in a given scene, the soundperson can do a better job of recording the sound effect to match.

The soundperson should avoid the temptation to record any more or less elements of the effect than called for by the editor. For instance, if the editor needs the sound of a hammer striking a nail, don't embellish the track with background construction noises and wild dialogue ("Hey, Ralph, hold this nail for me!").

Some effects don't readily lend themselves to live recording. Ever try to get the footsteps of a giant dinosaur? Editors and sound mixers will often conspire to create a sound effect that doesn't exist in real life (or does exist but doesn't lend itself to be easily recorded). Effects may be completely synthesized on electronic instruments, or may be based on taking real sounds and electronically modifying them. Most effects are composite effects, created like a musical chord, built up from a number of simpler sounds (all of which may have also been modified).

Finally, many sound effects are 'dubbed' in, by means of a process known as "Foley". Briefly, the Foley process consists of recording the sounds of an artist while he mimics the actions of an actor on the screen. A short section of the film is projected over and over again for the Foley artist (also known as the "Foley walker"). The artist watches every movement of the actor very carefully, and mimics both the action and rhythm. The artist performs those same actions using a variety of props, and these actions are recorded in sync with the picture. For instance, the Foley walker may imitate the actor taking out a gun from a holster, or sitting down in a squeaky chair, or shuffling some papers in his hand.

In addition to mimicking simple actions, the Foley artist will also dub fight punches, hugs, kisses, swordplay, head scratching, and anything else that emotes sound—no matter how subtle.

Then there are the footsteps, which are what Foley people are best known for. Every actor walks. Sometimes we see his feet moving, other times we only sense the movement because the camera is in close. The Foley artist will recreate all of the footsteps of each actor, regardless of whether or not the steps are seen or implied. To assist in making the Foley footsteps match the environment on screen, the inside of the Foley recording stage is equipped with a multitude of small troughs known as Foley pits. Each Foley pit is a small rectangular area filled or covered with a different texture, such as concrete, dirt, linoleum, carpet, hardwood flooring, marble, grass, brush & twigs, sand, cobblestone, steel plate, and so on. In addition, there is a small wading pool of water for creating aquatic sound effects. The Foley walker also has access to a wide array of footwear, ranging from men's combat boots to women's high heels (irregardless of whether the Foley artist is male or female!) in order to accurately recreate all of the footsteps as well as mere body shuffles.

Dialogue

The fourth and final major element of the soundtrack is dialogue, or speech. Audiences want to hear what the actors are saying!

Dialogue in a film takes on, ultimately, one of two forms. Either the words are spoken by an actor on screen, with the lips visible to the audience; or, the words are spoken by an actor off screen, or by an actor on screen whose face is not visible. Dialogue from an actor whose face we see is termed "lip-synch", because the words must match the movement of the lips. All other dialogue is considered "wild", since it does not have to sync with any on screen source.

The recording of dialogue usually occurs on the set during filming, and this is referred to as "production dialogue". Sometimes, while actors are on the set, but without cameras rolling—the company will record additional lines of dialogue to be used later as "wild lines". Examples of wild lines that would be recorded on the set for future use include other halves of phone conversations, shouts or greetings from afar, background ambiance, alternate dialogue (to cover profanity in event of television broadcast), narration, or any dialogue that talent tends to stumble over (the editor can either meticulously replace the lip-synch a word at a time, or cut to a reverse angle that hides the actor's lips and just lay in the lines).

Sometimes, for any of a multitude of reasons, production dialogue is unusable and must be replaced during post-production. Sometimes a production mixer is either incompetent or suffers an equipment malfunction. Sometimes, the problem is totally beyond the help of the mixer, such as a loud generator or continuous aircraft. Directors often shout screen directions and talk during dialogue. There are all sorts of reasons and excuses for having to replace dialogue on occasion, some of which we can control and some of which we can't.

When a production track does need to replaced, editors use a process known as "A.D.R.", which is short for Automated (or Automatic) Dialogue Replacement.

In the old days, dialogue replacement was done by physically cutting out short sections of the original dialogue (consisting of one or two lines) along with the appropriate picture. These sections were formed into continuous loops. That's why the process was called "looping". A projection system would run a loop of picture along with the corresponding loop of original sound in sync with a loop of fresh stock threaded up in a recorder. The actor would watch the film clip, listen to his original track on headphones, and re-perform each line aloud.

When the process was complete for each loop of dialogue, the editor would painstakingly replace each section of picture along with the newly recorded sound.

Modern technology has greatly simplified the process. In the A.D.R. process, the physical loops have been done away with. Instead, the entire reel of picture and the entire reel of original sound are threaded up in sync. An entire reel of blank audio stock is set up on a recorder. A computer is fed the start and stop footage of each "loop" that needs to be recorded. All three machines roll down, in sync, to the first "loop" and the process begins. The actor watches the projected footage and listens to the cue track on headphones. A series of three audible beeps alerts talent as the system rolls forward towards the record start point. His take is recorded on the blank stock. At the completion of each take, the computer rewinds all three machines back to the programmed start point and the process repeats itself. When the loop has been successfully recorded, the entire system moves ahead to the next programmed set of cues.

After the A.D.R. recording process has been completed, life is considerably much easier for the editor since all three elements—picture, production sound, A.D.R.—are already in sync with each other throughout the length of the entire reel. To replace bad original sound, all the editor would have to do is put the three elements in a gang synchronizer on his editing bench, roll down to the first cut point, and splice in his track. 550' at the picture and 550' on the production sound reel would correspond to 550' on the A.D.R. reel.

A.D.R. can also be recorded using a multi-track recorder with SMPTE timecode to sync with picture; or with a non-linear editing system that contains picture and audio on its hard drive. The basic principles remain the same.

WHAT IS PRODUCTION SOUND?

We have spoken briefly about Production Dialogue. Earlier on, we also mentioned recording sound effects on the set, either sync or wild. Combine these concepts, and what unfolds is "Production Sound"—namely, everything that is recorded on the set during production.

Production Sound should be thought of as raw material for the editors. It is standard practice for editors to divide the production soundtrack into separate tracks for each actor and for sound effects, so as to provide the most flexibility and control to the re-recording mixers during the final dub (mixdown). Therefore, editors tend to prefer clean, isolated dialogue with effects and ambiance recorded separately.

However, the expression that "you live or die in the dailies" seems to countermand the notion about Production Sound being raw material earmarked for post-production embellishment. A production soundtrack free of effects and ambiance is candy to a dialogue editor, but will sound sterile and unnatural to many producers (who usually know a lot about business and little about editing).

So whom should the Production Sound Mixer strive to please, the editor or the producer? Think about it and draw your own strategy. No one said this game would be easy, but you were forewarned about the importance of compromise.

Very often, though, the production sound track recorded in the field may be the end product itself, except for the addition of a little music, possibly some narration, and an odd effect or two. This is especially true in low budget productions, where there seldom exists any budget for sound editing nor A.D.R. In these instances, the production mixer must be extra diligent in acquiring crisp dialogue tracks complete with perspective, sync sound effects, and ambiance. (As you can see, there is a lot more to this business than just knowing how to plug a microphone into a Nagra or VTR!)

BRIEF OVERVIEW OF THE SOUND EDITING AND POST-PRODUCTION PROCESS

Sound for film - The traditional double-system process

After the production tracks have been recorded in the field, the ¼-inch audiotape are sent back to the lab or studio for transfer to either 16mm or 35mm sprocketed magnetic film. This initial transfer is a most critical stage for the audio (and the person who recorded it), since a poor transfer can easily induce lots of distortion.

An editor then syncs up the dailies, by aligning the clapsticks on both picture and sound and matching the lengths of the two reels (either adding leader or cutting out garbage). After the dailies have been synced, both picture and sound reels then have matching edge number codes inked on so as to facilitate keeping track of sync later on during editing. (Coding may occur after the screening of dailies.)

Each previous day's footage is screened in sync at the "dailies". Here, the producer, director, client, and key crew members get to evaluate what was shot. It is in this projection room that we get to "live or die". It is very important for the sound mixer to attend at least the first few dailies screenings (if not all of them) in order to ascertain that the production tracks are not being played back distorted due to bad transfer or poor screening room facilities!

From there, the picture and production soundtracks go to the picture editor for rough cut.

After the completion of the rough cut, the material is duped. The picture editor keeps the original edited workprint and a dupe of the production soundtrack. The sound editor receives a dupe of the edited workprint and the original of the spliced production soundtrack for sound editing.

The sound editor performs several tasks to the sound. The dialogue of each main character is separated and spliced onto individual tracks so as to facilitate the final mixdown.

In fact, all of the sound elements (dialogue, effects, music, narration) are eventually checkerboarded onto separate tracks. This permits the dubbing mixers to establish individual volume levels and equalization for each track, and are thus able to deal precisely with overlaps, fades, special effects, and any changes that occur end to end with each other.

Unwanted ambiance occurring on the same track (such as between an actor's words) are cut out. This editing process is known as "flipping the track", because in 35mm that is literally what they do. Since 35mm has sprocket holes top and bottom, the editor merely has to invert the unwanted section so that the base side goes where the (sound) magnetic emulsion was, and vice versa. In 16mm, they use leader.

Sounds of very short duration are merely erased from the track by mechanically removing some of the magnetic oxide emulsion with a razor blade, sandpaper, or cleaning solvent.

Totally unusable dialogue is replaced with A.D.R.

In the course of dialogue editing, the sound editors will often come across a section that is full of unnecessary splices or contains damaged sprocket holes. Requests will be sent to the Sound Department or lab to have these takes retransferred from the original ¼-inch tapes. These reprints will then be meticulously spliced in to replace the damaged sections. (This is why all transfers must be done to industry standard on well maintained equipment - so that reprints intermatch original.)

Sound effects are added wherever necessary, including the creation of ambient backgrounds. Foley is recorded for the footsteps, body movements, and some sync sound effects.

Narration tracks are laid in, as needed. Checkerboarding is used so that the mixers can correct any audible changes that may occur when different sounding takes are joined end to end.

Finally, music editors will assemble the music tracks, cutting them to match the appropriate picture sections in terms of length, climax, and fade points. As with dialogue and effects, the music tracks are checkerboarded for the mix.

The film Mix

After all of the elements have been assembled onto separate reels and checkerboarded, the sound is ready for "re-recording", "mixdown", or "dubbing"—as the process is known as. (Although some people also think of foreign language replacement as "dubbing", that is not the correct usage of the term. In Hollywood, "dubbing" means mixdown—not A.D.R. and not language replacement.)

The first step are the "pre-dubs". This involves pre-mixing all of the individual checkerboarded tracks of each element down to just a few in number.

Since, on a major motion picture feature, there can easily be as many as sixty or seventy individual tracks for every one reel of picture (approx. 10 minutes worth), and ten or eleven reels of picture to a full length movie—we are talking about a truckload of sound!

On a smaller show, such as a documentary, there may be only several individual tracks.

Using a geometric (or pyramid) type progression, all of these reels are eventually mixed down to a manageable few. For instance, let's say there are 5 production dialogue reels, and 3 A.D.R. reels. Eight reels, just for Dialogue, is difficult for one set of hands to manage. But all of these tracks could be mixed down to just one or two Dialogue reels. Then we pre-mix the fifteen or so reels that make up only the ambient backgrounds, and pare those down to just two or three. Similarly, reduce forty or so sound effects and Foley reels to just three. And so on.

Now, we are ready for the final mixdown. No longer are there sixty reels, but perhaps nine. These nine, which now include Dialogue, Effects, Music, and Narration can now be mixed down to their final composite levels in relationship to each other.

However, in real life, the elements are not actually combined into one monaural track. Instead, they are mixed down to three monaural tracks—Dialogue, Music, & Effects—all on the same piece of sprocketed film (known as fullcoat or three-stripe). Producers keep these three elements separate in case they should ever later want to modify the finished film, such as by replacing the English dialogue with a foreign language, or updating the music to appeal to a different audience.

It is because of this eventual mix to a "DM & E" that editors strive to isolate as many effects as possible from the production dialogue tracks. That way, the dialogue can be replaced without having to replace all of the sync sound effects that would be lost with it.

On a stereo release, the mixers would end up with a DM & E for each stereo channel. Basic stereo would require two: Left, Right. Older 35mm stereo required four: Left, Center, Right, Surround. 70mm used six: Left, Center-Left, Center, Center-Right, Right, Surround.

Current Dobly Digital and D.T.S. requires six: Left, Center, Right, Left-Surround, Right-Surround, Sub-woofer. S.D.D.S. uses eight: Left, Left-Center, Center, Right-Center, Right, Left-Surround, Right-Surround, Sub-woofer.

Sound for film/video non-linear

The modern audio post-production process for non-linear editing is somewhat different than for traditional motion pictures. Computers allow us to perform the same tasks, but using virtual tracks of picture and sound, rather than with physical reels of material.

Although the technology used for editing a "video" is pretty much the same, low-budget production companies often do not take the same care with "video" that they would with "film". Location production may be rushed and understaffed, with less attention being paid to sound and lighting.

To screen dailies in film, the sound first had to be transferred, synced up, and projected in interlock. To screen dailies in video, one only has to playback the videotape.

Therefore, the screening of the video dailies is not the ritual of importance that it is in film. Very often, producers will ask for an immediate playback of the video just after it has been shot—right there on the set.

The next step, after production, consists of the first picture edit.

Film is transferred in a telecine to video, along with matching keycode or SMPTE time code numbers. Sometimes the location audio is transferred in sync with the video. Other times, only the picture is transferred to video, and then the audio is added in the editing system. Note that when film is converted to video, there may be a time change (slowdown) of 0.1% to accommodate the difference between 24 fps (film) and 29.97 fps (video). Audio must be converted (pulled down) by the same percentage in order to remain in sync.

If you shoot in video, then there are no time changes to worry about.

Editing can be "on-line" or "off-line". Film and broadcast video are usually edited "off-line" because the editing system is only creating a blue-print (EDL or edit decision list) on small format (or non-broadcast quality) video that will be used later on as a guide for conforming the film negative or re-editing (rendering) the original videotape on an extremely high quality system.

On-line editing refers to cutting a project on an editing system with the intent of going directly to your mastering format or release format from the output of that same editing system. This is a common practice in low budget video production, such as wedding & events, corporate, documentary, and many projects not intended for big-screen or major network broadcast.

On some shows, the producers will first do what has been nicknamed an “off off-line” first edit or “pencil edit”. The original videotape is duped onto consumer VHS format tape along with a time code “window dub” (S.M.P.T.E. time code is keyed onto the picture portion, like credits). The producer can view the tapes on any player system, noting down the approximate start and stop time codes of any take or scene. This information is passed along to the editor.

After the off-line or rough cut is complete, the video show goes to “on-line” editing. During this on-line session, all of the edits made on the off-line version are reproduced using the original videotapes recorded in the field. During this on-line session, all of the transitions (dissolves, wipes, fades) are re-done, along with the addition of titles and special effects (flips, spins, split screens, etc.).

Due to the complex electronic nature of video editing—and the scientifically unproved yet widely recognized influence of supernatural occurrences on computerized edit controllers—there is bound to be at least a few edits that differ in length or visual effect from the off-line version.

After the on-line version is complete, video editors begin work on the soundtrack. The process of sound editing and mixdown is known as “sweetening”.

The first step in sweetening is to transfer the edited version of the production track onto a multi-track Digital Audio Workstation (non-linear audio editing system). Matching time code is used to maintain exact frame sync between the audio and the videotape. This entire phase is called “laydown”.

The editor splits his production track into separate elements by re-recording portions onto remaining open tracks of the multi-track. Sound effects, narration, and music are transferred over from the other audio sources onto the multiple tracks with frame accuracy.

If needed, A.D.R. and Foley can also be recorded using special software programs (or external recorders equipped with time code).

After all of the individual tracks have been built, checkerboard fashion, onto the virtual multi-track—the editor then begins the task of final mixdown. Depending on the budget of the show and the number of tracks involved, the mixer may create a DM & E. Otherwise, the tracks will simply be mixed down to a single monaural or a stereo release format

The final process is to transfer the mixed soundtrack back onto the finished videotape from whence it came. This is called the “layback”.

On a major film, the individual audio tracks would be transferred to a disk or removable hard drive and then taken to a post production sound facility for "re-recording" (final mixdown). In a large theatre environment, the picture would be projected onto a large screen, and the tracks would be accurately mixed for best presentation.

CHAPTER SUMMARY

There are four basic elements of a motion picture or video soundtrack: narration, music, sound effects, and dialogue.

Narration can be recorded sync to picture, where the narrator comments on what is being projected, as it is being projected. The other method, which is the preferred way of doing things, is to record the narration wild from a script and to edit the lines in opposite the appropriate footage.

Music provides an emotional backdrop to a film. Music can be acquired from a music library ("canned") or it can be an original score.

Sound effects are either frame accurate ("hard") or wild. FX can come from a library, or can be recorded on the shooting set (either sync or wild). Effects can be recorded later during editing, or they can be created & synthesized. Footsteps and other sync sound effects can be recorded in a Foley session.

Dialogue consists of either lip-synch or wild lines. It can be recorded on the set, or looped back at the studio by means of A.D.R.

Production sound is the complex craft of recording live dialogue and sound effects on the set during principal production. Usually it is raw material for the editors, but sometimes it can be the end product itself.

Film sound editing includes: transfer of dailies; syncing picture & sound; screening the dailies; picture edit w. production track; sound edit; pre-dubs; and final mixdown.

Video sound editing includes: playback of composite picture with sound; off-line picture edit; on-line picture edit complete with visual effects; laydown for audio sweetening; building tracks on multi-track; mixdown; layback to completed videotape.

PRE-PRODUCTION PLANNING

The route to achieving good production sound

Good production sound does not happen by accident nor on its own. It requires concerted efforts from all the production executives (producer, director, production manager) as well as from members of the crew.

Achieving good Production Sound, as does every aspect of filmmaking, hinges upon decisions made early on during the pre-production process.

Location Scouting

One of the most critical areas for Sound is the selection of the shooting location. All too often, sites are selected without even remote regard for noise or acoustic conditions.

Unlike the camera lens, which can frame out those items which the director does not wish the audience to see, the microphone cannot be particularly selective in what it hears. Unwanted background noise is omnipresent, and will permeate a set regardless of camera framing or the addition of a few flats & props.

For example, imagine the production of an 1860's period western. The camera operator can remove a tall radio tower gridwork from the visual background by either framing it out or blocking it from view with a strategically placed foreground cactus tree. The sound mixer, on the other hand, has no simple method of "framing out" distracting sound such as a busy freeway directly behind the setup.

In this situation—a western being shot in an urban location—the odds are extremely high that all of the dialogue would have to be replaced by means of ADR, unless some science-fiction quirk in the storyline could successfully explain the presence of freeway noise during the 1860's!

In a less extreme example, imagine the difficulties involved in trying to record dialogue or interviews in tightly cramped, hard-walled offices that sound like echo chambers. As if the acoustics weren't evil enough, add to this nightmare the sporadic rumble of a central air conditioning system along with the frequent intrusion of nearby office typing, phone calls, loudspeaker pages, and computer printers.

If you think that either of these examples are just bizarre creations of a twisted author's imagination, then you haven't been out on very many shoots yet!

One time, I was hired to record sound on a video interview with the legendary Mother Theresa. The site that the producer and director selected was virtually the chamber of audio horrors described above. We videotaped in the library of a convent. The room was a visually acceptable array of book shelves, and with some artistic rearranging of the volumes it transformed into an okay background for picture.

As for acoustics, forget it! Hard walls and bare floor all contributed to extreme echo. Noncontrollable air conditioning and venting created a distracting level of room noise. Add to all of that a ton of machine noise from the adjacent physical plant. What we had was the Dante's Inferno of Sound!

Although I did the best that I could, there was no way that this saintly woman was going to sound as good as she should have for an interview of this magnitude. Considering that this video interview relied mainly upon what she had to say as opposed to what she looked like—the production company really blew it when they came up with this location.

Sound, despite its importance to the final product, usually gets very little consideration on the set—or BEFORE.

Scout with your ears.

Prospective location sites (and even many so-called studios) should be evaluated for their conduciveness to good sound as well as good picture. Location scouts should learn to examine a site with their eyes closed and ears open—literally—and for about ten to fifteen minutes minimum.

In fact, I know of one professional scout who goes so far as to plant a cassette recorder at each location and then returns later in the day to retrieve the recording. In this way, her producer/clients have the option of asking their own soundpeople for opinions as to the workability of a proposed location.

Scout with regard to time of day.

It is equally important, when evaluating a location, to do the scouting on the same day of the week and hour as the proposed shooting schedule.

One show that I was involved with had chosen to shoot at a ranch out in the country. When the producers visited the site, they did listen for sound and found the location to be as pastoral as a storybook. That was on a Wednesday. The producers figured that a weekday would bound to be noisier than the weekend on which they planned on shooting. Or so they thought...

Come the Saturday of the shoot, the ranch itself was as quiet as could be. But just a hoot 'n holler down the road happened to be the local dirt-bike racetrack and play area. All day long, both days, our takes were continuously interrupted by the roar of un-mufflered motorcycles. Some of these weekend riders even did us the added favor of performing practice runs up and down the roads on either side of the ranch.

What more is there to say? Scout locations carefully and wisely, with your ears as well as eyes. A few extra dollars spent in checking a place out can be worth tens of thousands in either lost production time and/or post-production "repairs".

Putting together the crew

Attitude is important. Professional results in any phase of production will not happen unless everyone involved thinks, identifies, and performs as "professionals".

Simplistic as it may seem, no producer/director is going to achieve consistently good Production Sound without having a qualified team officially assigned to that crew function.

Choose your Sound Mixer carefully.

For reasons that have never made any sense, student productions (and even some low-budget professional productions) often delegate the position of Sound Mixer to whoever on the crew seems to have nothing better to do. It seems like the "best people" are asked to do camera; others to fill in on lighting & grip; someone organized and literate to handle script/continuity; more bodies to supervise make-up, wardrobe, and props; and finally, somebody to run the Nagra or DAT.

Somebody?

And if "somebody" is lucky, maybe "sound" gets another "helper" to hold the fishpole and point the mic. Usually though, that same "helper" is also expected to do double duty as an electrician or grip, and gets to rehearse with the mic only after the C-stands and flags are adjusted.

With production attitudes like that, is it any wonder that the resulting production sound is less than breathtaking? Perhaps a more apt phrase might be "hardly usable"!

The Sound crew should only wear one hat.

You will not achieve good sound with anything less than a "dedicated" soundperson and crew! By dedicated, I do not necessarily mean someone who has devoted his or her career to the pursuit of audio (though it sure helps); but at least someone who has devoted all of their attention ON THIS PRODUCTION to the pursuit of good production sound!

A meticulous sound mixer or boom operator does not have the time, concentration, nor the endless stamina to properly perform more than one job. Sure, times will occur when the sound crew can help out other members of the crew in setting up—and sometimes in those cases, the sound crew should lend a hand. I'm not suggesting that we all become prima donnas. But it is not conducive to good sound for the mixer or boom to be playing with lights or grip stands when, instead, they should have been paying close attention to blocking & walk-throughs, or busy miking rehearsals.

First priority must always be to do the job you were hired or assigned to do. In this instance, Sound comes first. This includes setting up OUR equipment; deploying mics; keeping an eye and ear on the director in case he changes the shot; watching the blocking; and miking the rehearsals. Anything else cannot be allowed to supersede those professional responsibilities.

There is no room for split allegiances. A grip ("helping out" on sound) will almost always throw down the fishpole and rush over to adjust a flag the second that the camera operator complains! That may help the camera crew out, but it deprives the boom person of a much needed rehearsal and leaves the mixer useless.

If any person is assigned to any department, then that person must act and react accordingly—these newly assigned duties must assume first priority! A transfer from one department to another must be considered a complete transfer (during the duration of that transfer and until the person is re-assigned back to their original department).

An important point to remember: when Camera says they are ready, then Sound is expected to also be ready! Directors do not like "waiting on Sound". Nor will they accept as a valid excuse the fact that we are late because we were too busy helping other people out.

Rely on people who absolutely know what they are doing!

Very few of us would serve as our own legal counsel in a murder trial, nor would we remove our own inflamed appendix. For those life & death situations, we naturally turn to the expertise of the best professionals we can find.

Well, career life & death for the novice director/producer can be decided in the screening room, so why should we act any differently? To increase the chances of success, employ an experienced specialist!

Don't wait until major mistakes have taken place either in the planning or production phases of the show. Consult with a professional at a point early enough to take advantage of his or her suggestions!

The seasoned mixer can often save the production company money during pre-production by pointing out equipment selection fallacies; anticipating potential location problems; highlighting complicated recording situations as well as offering solutions; and so on.

The advantages of having a professional sound mixer during the actual production should be rather obvious. Although Sound may look easy when it is done right, if you have ever attempted it yourself then you know it is not near as easy as it looks.

Even if the budget constrained producer cannot afford to hire the best, he or she should at least consult with them. A new producer may be surprised to discover that most of the industry's top mixers are very down-to-earth people and are usually happy to provide information and offer advice. In addition, the seasoned pro may be able to recommend the name of an aspiring protégé more willing to work at an entry-level rate.

In any case, it is always best to employ or at least pick the brains of someone who mixes Production Sound for a living as opposed to utilizing an inexperienced (though well meaning) novice who is likely to guess and fumble around.

Even the experts learn from each other

Learn from the old pro's as much as you can, and as often as you can. This advice applies especially to the aspiring or novice Production Mixer.

I have been in the sound business for well over a decade, yet I still find myself learning from peer professionals.

There is so much to learn, and only a lifetime to do it in. Only fools think they know too much to continue learning.

As you gain experience, you will discover that the gaps between your knowledge and that of your respected peers lessen. Never-the-less, every now and then you will discover a fallacy in one or another of the old truths; someone will turn you on to an even better way of solving a particular problem; or pass along advice on some new piece of equipment.

Ask lots of questions, but be wary of the Rental Clerks

Rental Technicians are rarely experienced in the ways of Production Sound. The job of a technician working for an established Equipment Rental Facility is mainly that of shipping clerk. They take orders, fill orders, and jot down serial numbers. In the best of cases, they may actually know how to set up and operate the hardware.

There is a major difference, however, between operating equipment on a test bench and mixing an actual show! The craft of Production Mixing involves dealing with a great number of location variables, such as camera, lighting, blocking, human nature, time, budget, requirements & capabilities of post-production, and so on. These are areas in which the majority of Rental Technicians are totally unaware. Unless you specifically know otherwise, always assume that these technicians have little or no real world, PRODUCTION EXPERIENCE.

If you ask them for advice, most of them will not admit that they are ignorant and/or inexperienced. They will not inform you that they have recently graduated college and have taken this job as an entry level position into the film industry. Instead they will try and answer your question the best they can based on reasonable (though not always correct) assumptions, or based on what they would like you to rent in order to maximize profit or minimize their effort.

Always take the Professional Approach.

Sound Mixing can be a lucrative profession, but it does require a combination of skill and political tact to keep getting the work.

Professional image and reputation are critical! If you want to survive in this business, it is imperative to always take the Professional Approach. Do the job right... regardless!

If budget or conditions won't let you do it the way you know it should be done, then turn down the job and walk away. It is better to have a reputation for being excellent (though a little stubborn) than for being easy (but incompetent).

There are no apologies nor excuses run under the dailies. Good sound is always expected (and taken for granted). Bad sound, on the other hand, is always attributed as your fault. You will never heard it said that "even though the soundtrack was poor, the Mixer did a good job considering that we made him use bad equipment and no boomman." Instead, they will remark that they should have hired so-and-so, since that Mixer did a fine job on the last shoot.

Producers and Directors find it much easier to blame the Mixer than themselves.

On the set, be congenial and friendly. Remain cool and calm; avoid shouting. Stay out of people's way. But on the other hand, remain strong, confident, and aggressive when necessary. Press for what you know is right. Don't back down easily or be intimidated. Fight for every inch of closer mic placement, and any other reasonable improvements for the good of sound.

But very importantly, always arrive on any set with the best in terms of personnel and equipment! If you surround yourself with a skilled team of people, and bring along all of the equipment necessary to do the job right—then you have pushed the odds in your favor of recording great Production Sound in the face of the chaos and confusion that run so rampant on many productions.

Personnel that compose a professional Sound Crew

The basic production sound crew consists of the Mixer, the Boom Operator, and the Utility Sound Technician.

Production Mixer

The Mixer is the head of the Production Sound Department (usually just called the Sound Dept.) on a show. The Mixer is responsible for recording the dialogue and effects necessary for the editors to cut the show. Crew and equipment contributing to that end fall under the supervision and control of said mixer.

Politically, it is the Mixer who interfaces with the Director and Producer in pre-production and on the set.

The Mixer is ultimately responsible for finding out what is going to happen in the current shot; for making suggestions to the Director (when appropriate); for working out a miking strategy/approach (often in conjunction with the Boom Operator); for mixing and recording the audio signal; and for approving the recorded take to the director as "okay for sound".

In conjunction with the Script Supervisor, the Mixer will make sure that all wild lines and wild sound effects get recorded.

In union parlance, the Mixer is known as a Y-1 or an A-1. The Y-1 designation is from the IATSE Local 695, which is the Hollywood sound union most prevalent in feature filmmaking and episodic television series. On the broadcasting side, the term A-1 is more common, and is used by NABET.

Salary range for a Mixer depends on the budget and nature of the production. On non-union industrial or corporate shows, Mixers earn approximately $350 to $600 per day in Los Angeles. (Note that salary structure will vary for different regions of the U.S.)

Union shows, of course, tend to pay better. Union scale is approximately $440 per 9-hour day, but on the more typical 12-hour long workday—overtime brings it closer to $600. The going rate for commercials is also $500 to $600 per 10-hour day.

Boom Operator

The Boom Operator (Boomman, Boomperson, etc.) is one of the most underestimated functions on the entire crew. Layman wrongfully assume that the Boomperson is merely someone tall enough and strong enough to hold up a big stick with a mic attached to the end. Hence, novice producers often assume that a grip or "someone else not too busy" can be assigned to work with the Mixer.

On the contrary, Hollywood has learned to appreciate and respect the skills brought to the set by an experienced Boom Operator. Most Mixers consider the Boom Operator as their equal partner on the set. With increasing frequency, the closing credits of feature films group the names of the Mixer and Boom Operator together under the single heading of "Production Sound".

A Boom Operator needs to be in excellent physical shape in terms of upper body strength. It is no easy feat to hold a fifteen foot long fishpole over your head at full extension, particularly with microphone, shockmount, and windscreen attached to the end. Especially over the course of a grueling 12-hour day. And day after day.

However, holding up the fishpole is only the beginning. A Boom Operator needs to know what to do with that mic on the end of it. A knowledge of microphone sensitivity and pick-up patterns is crucial.

The microphone must be cued (aimed) and/or repositioned overhead from actor to actor as they speak in turn. Cues cannot be late, or else the first words will be lost and the take ruined.

In order to accomplish this, the Boom Operator must be able to quickly digest parts of the script, but mainly to memorize the action of the scene from rehearsal (or first take) and to pay attention to subtle body language that forecast when talent is about to speak (eye movement, intake of breath).

Some actors shout while others hardly whisper. Recording dialogue requires balancing the two diverse levels to within an acceptable range. A lot of this is done by the Boom Operator, by taking advantage of microphone pick-up and rejection angles. By favoring the soft voice, and playing the overbearing one slightly off-axis—it is possible to achieve a pleasant balance of the two vocal performances, without having to resort to extreme raising/lowering of the volume level

back at the mixing panel or recorder end. (Note that ping ponging the volume level up and down during the take might balance the voices, but would create editorial havoc with the background sounds.)

Maintaining framelines and keeping the mic out of the shot is required, but so is keeping the mic in as close as possible. What with zoom lenses and dolly shots, this can get quite tricky. I have worked with several boommen who have become adept at judging whether the camera is zoomed in or out by observing the angle of camera tilt on the tripod head.

Fishpoles and microphones cause shadows. A working knowledge of lighting is necessary, if one is going to create the least amount of visual interference. The skilled Boom Operator will eyeball the lighting in relation to talent moves in order to determine from where and at what angle to boom the shot. Sometimes, it may become necessary to tactfully make constructive suggestions to the gaffer regarding alternate light placement, or the use of flags & cutters to mask boom shadows.

The Boom Operator must be attentive at all times to what his or her mic is picking up in relation to all of the other mics on the set. It is for this reason that the Boom Operator wears headphones and monitors the complete program mix, not just the boom microphone. In the event of microphone phasing problems (two mics on the set picking up the same sound at the same time, creating cancellation), the Boom Operator and the Mixer must both react immediately in order to save the take. The Mixer fades down one of the offending mics at the same instant that the Boom Operator strategically repositions the overhead mic.

Other problems on the set may also require instant reaction from the Boom Operator, such as loud or soft delivery of lines, ad-libs, sound effects, and actors missing their marks.

Boom Operators may also need to skilled on the operation of the Fisher Microphone Boom. They also need to know how to rig lavaliers and radio mics.

In fact, the Boom Operator should be qualified enough to take over for the Sound Mixer in the event of absence or potty break.

The Boom Operator needs to have one final attribute. He or she must be telepathically on the same wavelength as the Mixer. Somehow, with no or minimal handsigns or verbal communication, the Boom Operator and Mixer must be able to react to situations like a set of Siamese twins.

It is because of this extreme need for partnership on the set that the Mixer should always demand the right to choose the Boom Operator. For a Producer to saddle a Mixer with an inept or incompatible Boom Operator is to court disaster. For a Mixer to compliantly accept such a Boom Operator is to jeopardize his or her own career, since ultimately the Mixer is responsible for what they hear in the dailies. It is better to turn down an assignment, than to have it turn out badly.

The Boom Operator is designated in union parlance as a Y-8 according to IATSE Local 695. In broadcast, the designation may be an A-2.

Salary range.for a Boom Operator is from $250 to $350 on non-union industrial or corporate. Union shows and commercials will pay $350 on up for the basic 9-hour day, plus overtime. Commercial rate of $400 is not at all uncommon.

The IATSE requires a minimum of a two-person sound crew (Mixer and Boom) for any day that dialogue is to be recorded, though a three-person crew is pretty common. Personally, I find that there are very few situations where less than a two-person crew is physically adequate, other than sound effects gathering or quick ‘n dirty ENG.

Utility Sound Technician

The above mentioned third person on the sound crew is known as the Utility Sound Technician. In the old days, the position might have been known as Cableman. As a result, a lot of people think that all a Utility person is needed for is to wrangle mic cables.

Back in the Golden Era of Hollywood, cameras and sprocketed sound recorders (not exactly portable, but at least the trucks that carried them could drive around) had to be physically linked by thick, three-phase power cables that drove the sync motors. These cables were huge and heavy. Also, in those days, microphone technology was nothing like it is today—hence the need to rig a fair number of mics strategically all over the set. So there was a definite need for a few cablemen!

Today, what with crystal sync, portable recorders, radio mics, and condenser microphones—there is no longer the physical need to run thick cables over great distances, nor even the need for as many mic cables

But there is still the need for at least one more person on the sound crew, namely the Utility! The main function of the third person is not to run cable, but to run boom.

Very often, the dialogue will span a distance greater than one mic boom can deal with, due to the time and travel required to cue from one actor to a distant one. The solution is to deploy a second boom or fishpole.

Radio mics require skilled hands to test them and rig them on actors. During the take, receiver antennas must often be "boomed" to keep up with action.

Microphone cables must still be rigged for plant mics hidden in the set; and sometimes there is still the need to walk cable behind the boom operator (although this can be done by anyone).

Scenes shot to sync playback of music or special tracks require a Playback Operator—a skilled person to cue up and operate the playback deck.

Finally, it is valuable to have another trained person on the sound crew who can fill in at anytime for either the Mixer or the Boom Operator, or who can go off and record 2nd unit on their own.

Utility Sound Technicians are not common on non-union industrials and corporate productions. When they are present, their salary can range from as little as $75 per day on up, depending on their skill and necessity. Sometimes, they can earn as much as the Boom Operator, particularly if they are needed frequently for 2nd Boom or sync playback.

In union parlance, the Utility Sound Technician is designated Y-7a. Scale pay rate is approximately $300 for a basic 9-hour day, plus overtime.

Others on the Sound Crew

Depending on the nature of the production, other personnel may need to be added to the basic crew.

Additional Boom Operators may be permanently needed, particularly in multi-camera "live" shows. Sometimes on a regular feature or episodic TV series, such as "E.R.", a second Boom Operator may be normal in addition to the Utility Sound Technician.

A specialist Playback Operator is usually brought in on situations calling for extensive or complicated playback sequences. Good Playback Operators can understand and read music, as well as converse in music phraseology with composers and choreographers regarding cue points.

The proper equipment

In addition to needing the right personnel, the achievement of good Production Sound requires having the right tools.

Don't leave the choice of equipment up to others.

The Mixer must always assume responsibility for the selection and preparation of the equipment package.

If arranging for equipment is left up to the production company, they will inevitably only order what they feel is economically essential. Since the people who might be ordering the equipment are probably not experienced sound mixers, that means you can almost certainly expect to be lacking a few items that are essential.

Similarly, if you are putting together your own package and ask the production company what you will need, they might also lead you astray. Ask anyway — sometimes the information that they give you is useful, but plan for contin-

gencies.

For instance, I once mixed an automobile commercial where they wanted me to record a few lines that the storyboard indicated were to take place in an office interior. Easy enough. Most of the commercial consisted of exterior drive-bys of the car—no sound. So, I sat around at the base camp that had been set up in an outdoor parking lot, while the camera crew photographed the running car shots.

When it seemed like the car shots were nearing completion, I inquired as to where the office set was where we would be shooting the rest of the commercial. A Production Assistant pointed me to behind one of the trailers. There—smack in the middle of this noisy, windy parking lot—a crew was erecting three wall flats and some black drapes... an open air exterior set made up to look like an interior!

Had I originally trusted the production company and the storyboards, I might only have come equipped with a complement of interior microphones. However, experience has taught me to always pack as much equipment as I can transport.

My boomman and I rigged our exterior shotgun mic and heavy duty windscreen, and we did the scene outdoors with little problem. The framing was tight enough that we were able to close mic the scene so that traffic noise was not audible.

Moral of the story: Always be prepared.

Don't scrimp. Go with the best.

Proper equipment means having the best that is available to get the job done. If you cannot afford to own it, then rent it!

Use high quality microphones.

Choose the highest quality microphones that you can, such as the "industry standard" condenser shotguns from Audio Technica, Sennheiser, Schoeps, and Neumann.

In contrast, I would not choose as my first choice in production microphones any of the fine electret condenser systems on the market, such as the Sennheiser K6/ME66 or the Audio Technica AT835. Mind you, these are absolutely excellent microphones for the money. They serve well as reliable back-ups, or for low budget applications such as university film departments, event video, and independent wanna-be's.

But compared to the (more expensive) condenser microphones, the electret condensers currently on the market do not offer anywhere near the same exceptional reach and sensitivity. Although the sound from the electrets is comparable to the better mics when used at short range, if you have to increase the distance (such as to accommodate wider framing) the relative crispness and isolation of the dialogue will diminish noticeably.

Recording dialogue on the set is very difficult due to the constraints of camera and lighting. Better microphones such as the Audio Technica 4073a and Sennheiser MKH60 are worth the difference!

Also, do not think that any one microphone will do it all. Just as the camera requires different focal length lenses for different applications—there are different microphones for different situations.

A later chapter will cover the selection and application of microphones in detail.

Mixing panels are a must!

Another item that most budget conscious beginners tend to overlook is the value of a good mixing panel. Even if you are only going to be using one microphone at a time, the mixing panel is an indispensable tool. It provides the soundman with subtle control over the input at all times. Having this means of controlling (riding gain) on the input makes a major difference, especially when working with video recorders that only offer tiny tweaking knobs for microphone input. Good

mixing panels can be purchased for under $200, so there is no excuse not to have one!

Again, the selection and operation of specific equipment will be discussed in detail in upcoming chapters.

Prep your gear meticulously.

Your capability to record sound hinges strongly on the ability of your equipment to function when on the set. Having the best of gear, but not being able to make it work, is frustrating and career damaging. There are no apologies nor excuses run under the dailies!

Bottom line is that the Sound Mixer is responsible for checking each and every piece of gear that is earmarked for the shoot. Every recorder, every microphone, every accessory, every adapter cable, and every mic line must be checked with the same care and concern that a skydiver employs with his parachute.

Do not assume that because the equipment is coming from a rental facility (or studio sound department) that it has been checked. Rental technicians are generally underpaid, undertrained, and in a hurry. They don't care! For them, the worst that can happen is that they will have to deduct an item or two from your rental bill.

Also, rental techs and many soundpeople make the error of checking items individually, but not cross-checking them. All of the mics may work when bench tested, but may not work when used with a particular battery supply or mixing panel. Other mics may work with the one power supply packaged with them, but not with other supplies in your kit.

Plug everything into everything to insure complete compatibility and inter changeablility.

Be extremely careful to verify the contents of your rental contract. Make sure that no items that you originally ordered were forgotten or overlooked.

Double check to make sure that you do, in fact, have everything that the contract lists you as receiving. Be especially careful to log all of the misc. accessories, such as lavalier mounting clips, foam windscreens, adapters, cables, etc. Otherwise, you might find yourself being billed for all of the "missing pieces" that normally go out with a mic (but did not go out with yours!).

Allow sufficient time to prep your equipment. Plan to prep and pick-up your equipment at least one half-day prior to the shoot itself. For one thing, you will need ample time to check through everything. But in the event that you do discover a malfunction, the rental house may not have a replacement ready to go. If they need to subrent a replacement unit, or repair the broken one—that half-day buffer provides the time frame to do it!

Never leave the rental house without checking everything. Not only is it un-professional to show up on the set with equipment that you can't make work, but you are economically liable for everything on the rental contract. Anything missing or damaged can be billed to you the moment the equipment cases go out the door!

You personally, or at least a personally close member of your sound team, should prep the gear. If a production company driver is to transport the equipment from the rental house, make sure that you have prepped everything in advance of the pick-up. Sealing the cases isn't a bad idea, either.

Defining Equipment Packages

During the pre-production stage, it will become necessary to think and deal in terms of basic equipment packages. When defining equipment and budgeting in terms of these packages, bear in mind that these are simply terms of convenience. The specific contents of each package type will vary from studio to studio, rental house to rental house, and even mixer to mixer.

Members of the industry use these terms for generality only. When it becomes time to actually order equipment, forget the terms and get down to specifics: one of these, two of those, this adapter, etc.

Note that the use of the term "channel" is synonymous with "equipment package".

One-Mic Channel

The One-Mic Channel is the most basic of the generic sound recording packages (channels). It consists of a Nagra 4.2 sync recorder (or non-timecode DAT), headphones, one condenser "shotgun" microphone, a short mic cable, and a short fishpole.

The One-Mic Channel is the typical one-man band type of set-up. Picture one person with a Nagra strapped over the shoulder and a shotgun mic in hand. Applications would include sound effects gathering, wild lines, and documentary.

For documentary production, the sound mixer might want to add a couple of lavaliers for interviews.

Daily rental is approximately $75 to $100 per day.

ENG Mic Channel

This is the video equivalent of the (film) one-mic channel. Since audio in video is recorded on the VTR instead of a Nagra, the package does not include a recorder. However, since most VTR's do not offer adequate mic mixing (input control) and the fact that camcorders are carried by the cameraman—a small mixing panel is absolutely necessary.

Contents of a typical ENG Mic Channel would include a mini mixer (such as the Shure FP33); headphones; one shotgun mic; cable; short fishpole; and 2 lavaliers.

Video folk seem to be enamored with the use of electret condenser shotgun microphones, such as the Sennheiser K6/ME66 and the Audio-Technica AT835. Many video rental houses will supply these automatically, in lieu of the higher quality condensers such as the Audio Technica 4073 or Sennheiser MKH60.

Daily rental is approximately $80 per day.

Stage Channel

The Stage Channel is a complete sound recording package for theatrical style filmmaking (such as feature films, commercials, and episodic television series).

Contents typically include: one recorder; a production mixing panel; soundcart; fishpole; three condenser mics; duplex mic cable to the boomman; a few hundred feet of assorted single mic cables; and a few lavaliers. Sometimes more in the way of equipment, sometimes less. Again, remember that exact contents will vary from user to user.

Note also that two types of items are generally not included: headphones and wireless mics. As for headphones, it is normally assumed that the Mixer and Boom own their own. Wireless mics are a separate and expensive item, contracted for over and above the basic equipment package.

The term Stage Channel originated from the concept of filming on the soundstage or backlot of a major studio complex. All of the basic sound recording tools are present; but replacement equipment and specialty items are not included. In the event of equipment malfunction or special needs, it was only necessary to send the "third man" (Utility Sound Technician) a few hundred yards over to the studio "Sound Shop" for additional gear.

Stage Channels, although they may vary somewhat in the number of fishpoles and microphones, basically all share the concept of including only one (expensive) recorder.

Daily rental is approximately $150 to $300 per day.

Location Channel

What if the Nagra or DAT was to break? Do we cancel the shoot and all go home? Or do we just sit around for hours while someone drives back to the rental house for another?

In either case, it is not a good scenario. Therefore, the idea behind the Location Channel is that we have TWO recorders, as well as a very full complement of microphones and other needed equipment. The magic word is redundancy.

Location Channels are beefed up Stage Channels, and feature two recorders and plenty of equipment for major set-ups and contingencies. Radio mics are still extra, though.

A good rule of thumb is: If a replacement recorder is more than thirty minutes away (or you are shooting on week-ends, holidays, or nights when rental houses are closed)... then go out with a Location Channel! If the shoot is big budget and every minute lost can cost big bucks, then definitely equip yourself with back-up gear.

The difference in cost between a Stage Channel and a Location Channel is only $75 to $100 per day. That's a small price to pay for "insurance".

If the production company balks at the added expense, ask them to sign a waiver leaving you blameless for delay in the rare event of the recorder malfunctioning. They almost certainly won't sign such a document, but they will give in and let you rent a back-up machine.

Daily rental is approximately $250 to $350 per day.

Video Mic Channel

The Video Mic Channel is merely a Stage Channel complete except that there is no Nagra or DAT recorder. It is for film-style video production, and includes a soundcart, mixing panel, fishpole, condenser mics, etc.

Daily rental is approximately $125 to $150 per day.

Production Accessories

In addition to budgeting for the basic sound recording package, there is a wide selection of "add-on" items that should be given consideration while in the budgeting stage.

Wireless Microphones

Personally, I have always felt that these things should be called what they really are, neither "wireless mics" nor "radio mics", but "wireless cables". Because in effect, the transmitter and receiver of a wireless mic system do not replace the microphone itself, and virtually any type of microphone (with the proper adapter) can be used with the wireless system. The part that is replaced by the "radio" is the cable.

However, wireless mics is what they call them, so therefore I will. There are also a number of four-letter and other obscene words used to describe wireless mics because of their notorious unreliability on the set, but that is a different tale that I reserve for the section on wireless mics. This section is still on pre-production planning and budgeting.

Wireless microphones are relatively expensive to rent. Daily rates are approximately $40 to $60 per day, per channel. (When dealing with radio mics, the term "channel" is used literally. One system, consisting of transmitter and receiver, is assigned to each frequency.)

In addition to the daily rental fee, one must also budget for batteries. Wireless mics go through Duracell 9-volt batteries like kids go through candy. Most receivers use one to three batteries, which will last one or more days. The body-pack transmitters, on the other hand, use one battery which should be changed every few hours! Since fresh batteries (not the sale ones that have sat in the warehouse all year) can cost up to $3.00 each—you'd better figure on at least another ten dollars per day per unit.

Now for some simple arithmetic. If you only have one actor who needs to be wired, how many radio mics must you bring? If you only answered "one", you are quite an optimist (but hardly and experienced Mixer). Again, if the radio does not work, do we all get to go home early?

Wireless microphones are notorious for not working when you need them to. Not only are they subject to electronic malfunction or damage, but they are susceptible to every form of radio-wave interference that has ever caused your television reception to wobble. You name it—it can cause interference. Police radios, walkie-talkies, computers, video monitors, vacuum cleaners, aircraft, passing traffic, neon, radar, electronic flea collars and bug zappers, and the list goes

on. There are even supernatural “black holes”, akin to the Bermuda Triangle!

If you are going to use a radio mic, bring along extra units. Sometimes changing to a different unit on a different frequency helps. Sometimes not. The use of wireless mics is more of a mystic art than a science.

For convenience, four wireless mics may be housed in a case with central powering and fed from a single antenna. This is known as a “quad box”. Although the quad case itself will rent for $35 or $50 per day, some rental houses will package it at no extra charge when you rent four radio mics to go into it.

To improve reception, a more efficient antenna system other than the little rubber stubbies that come from the manufacturer may be used. Examples would be dipole antennas, directional TV-style antennas, ground-planes, and hi-gain systems. Add, as an option, another $15 per day for a special antenna rig.

So, if you envision the need for radio mics in your Location Channel, plan on approximately $160 per day for a quad box (four radio mics), plus batteries.

Ironically, many clients who are too cheap and fight me over the hiring of a boom person will suggest that I could make do with radio mics instead. Radio mics are not cheap, and even when you have them it does not guarantee that they will work. I’d rather have a boom man.

Fisher Microphone Boom

The Fisher Microphone Boom is one of the most versatile tools a sound crew could have. The Fisher is a studio boom featuring a dolly base, center column support, and an extended arm capable of telescoping as well as rotating (cueing) the microphone. The arm is high and out of the way, yet is able to reach & follow the actors even during complicated moves across or through the set.

Two standard sizes are available: a 16 foot arm; and a 27 foot arm. The 16 foot model is more popular for single camera film/video, and is easy to deploy in smaller sets. The larger, 27 foot version is more often found on the multi-camera sitcoms and audience shows.

Operation of the Fisher does require a little bit of training and a whole lot of practice. I would not bother to rent one unless I had a skilled boom operator on my crew. But in the hands of a person who knows how to use it, the Fisher can reach into places on a set and follow talent far beyond the capabilities of any handheld fishpole.

Daily rental is only approximately $35 per day, which is about half the price of a single radio mic!

Sync Playback Package

There will be times when it is necessary to play back a pre-recorded soundtrack on the set in order for talent to lip-synch and/or dance to it. Achieving lip-synch in filmmaking requires the same degree of sync precision in playback as it does in live recording.

To play back a soundtrack IN SYNC requires: 1) a soundtrack recorded with a sync pulse or timecode; 2) a portable recorder capable of reading the sync and resolving (playing back in sync); 3) a means of displaying the playback timecode to the camera; and 4) some means of making the playback track audible to the talent.

Sync playback will be covered in detail later in this book.

As for equipment, a basic playback package consists of a timecode recorder, a timecode slate, an amplifier, and some loudspeakers.

Daily rental for speaker and amp runs from approximately $75 on up, depending on the size of the speaker/amplifier system. A timecode recorder and slate is approximately another $150. (Note that a wireless system such as a Comtek is necessary to transmit the playback timecode to the slate).

Time Code Nagra or DAT

When the production company knows that the camera negative is going to be transferred directly to video for post-production and broadcast release, it has become industry practice to record time code onto the production audio tracks. During the transfer to video process, the film negative is rolled down in the telecine to the head of the shot or the clapstick slate and the time code is entered into a computer. That computer system then searches for the matching time code on the audio tracks. Then the controlling computer pre-rolls (backs up a few seconds) both the telecine and the audiotape machine, then both machines are put into FORWARD PLAY. It takes a moment for the telecine to reach normal speed. The computer monitors the time code of the audio, and adjusts the speed accordingly so as to achieve lip-synch. Picture and audio are then transferred together onto the videotape for future editing.

The most popular model Nagra that can record S.M.P.T.E. time code is the IV-STC, which is configured for two-track (stereo) plus time code. Daily rental of a Nagra IV-STC or timecode DAT is approximately $85 to $125 per day, or about double that of a Nagra 4.2.

Therefore, add about $100 per day to the cost of a basic Stage Channel, or add $150 per day to the cost of a Location Channel. (Sometimes a Location channel will consist of only one timecode recorder along with one non-timecode recorder as a backup.)

But we're not done yet! Most of the film cameras on the market are not yet equipped with their own time code generators. In order to make the time code visible on the film, the industry uses a clapstick slate (Denecke TS-3) that features a bright display of the time code coming from the Nagra.

Daily rental of the Denecke time code slate is approximately $40 per day.

Total daily rental for the timecode DAT or Nagra IV-STC and the slate package is around $120 to $150 per day.

Communications

The Sound Department is routinely asked to provide communications on the set.

The first type of communications you will be asked for is an audio feed from your mixing panel or recorder for the Director, Script Supervisor, and Client.

At its simplest, the Mixer would derive a spare headphone feed, plug in a long extension cable, and give the headphones to the proper party. If more than one person needed to monitor, then the Mixer would use some sort of headphone splitter box.

Crude, but effective.

There is a much better way, however. Wireless.

Industry practice is to deploy a miniature transmitter on the soundcart. Anyone who needs to monitor the soundtrack is given a miniature receiver along with headphones. Eliminating the long extension cords saves a ton of time, permits the Sound Mixer to move the soundcart as needed, and allows the listeners to roam freely about the set.

Listener freedom is very important to the Director. Prior to the use of wireless, Directors were notorious for destroying headsets at the rate of a few per day—since they inevitably would jump up from their chairs and rush onto the set, usually neglecting to remove their headphones FIRST.

The industry standard for wireless monitoring are the Comtek System or the ListenTech system. Transmitters rent for approximately $20 per day; and each receiver rents for around $15 per day. Figure on three receivers, so budget approximately $65 per day for Comteks.

Walkie-talkies compose the other main form of on-set communication. The most popular radio in use by our industry is the Motorola. A professional grade walkie-talkie—featuring 5 watt output, lots of channels, and frequency assignment on the motion picture bands—rents for around $20 per week. Small productions will commonly ask for at least four radios; larger productions may want as many as six dozen.

Expendables

Besides budgeting for personnel and equipment, don't forget about the expendable items. On even a medium sized production, the bill for these miscellaneous, yet important, sundries can get too expensive for the Mixer to absorb out of his/her own wallet.

Tape Stock

Make sure it is clear who is buying and bringing the stock. Don't automatically assume that the production company is bringing it, the cameraman, or the soundman.

Use only the brand and type of stock that the individual recorder is biased (set up) for. Most Nagras are currently calibrated for Quantegy 406/408 or BASF 468, although there are some set up for other stocks. Also, there are many Nagras that have been equipped with oversize plastic lids that allow the machines to use seven-inch reels of tape. Seven-inch recording stock runs twice as long (30 minutes at 7 ½ ips) as the standard five-inch (15 minutes at 7 ½ ips). Seven inch reels sell for around $8.50 per roll; five inch sells for around $6.50.

How many rolls of tape will you need? I find that on a major production such as a commercial, feature, or television episode my average usage was two or three rolls of 7".

Another way to calculate tape usage is to find out how much film stock has been budgeted for. A one-thousand foot roll of 35mm runs for about 11 minutes. A four-hundred foot roll of 16mm yields about 11 minutes. If you are using 15 minute rolls of tape (5" reels), then budget one roll of tape for every magazine of film. If you are using 30 minute rolls of tape (7" reels), then figure about 2 camera magazines per roll of sound.

Remember that audiotape is relatively cheap compared to film stock and the cost of production. Never be afraid to "waste" tape. Reload your Nagra while the camera crew is reloading, so as to avoid delays later on.

If you are shooting long takes, especially interviews, or the director likes to talk a lot before calling "Action"—then reload early enough to avoid any risk of running out during a take.

DAT tapes run longer, with 60 min and 95 min being common. Usually, one or two DAT tapes per day will suffice (apply the same 15 min/camera mag rule of thumb). However, also figure on not less than one physical tape per day, since you will be expected to turn in dailies.

Very often, the Sound Mixer will be asked to provide the tape stock and to bill the production company. Don't feel guilty about making a slight profit on the transaction. If the company wants to "save money", then let them foot the bill for all of the stock!

You are the one laying out the cash to buy enough stock for the shoot plus plenty of extra (just in case), but will only be reimbursed for what is actually used. That means that your cash will be tied up in tape stock until the next shoot. You cannot return unused tape stock to the dealer, since no respecting professional would ever want to go out with tape stock that someone else may have subjected to excess heat, etc.

More than likely, videotape stock will be provided by the cameraman or the production company. It is rare that the Sound Mixer is asked to supply videotape, unless he or she is also providing the video equipment. It never hurts to ask, just to make sure. What you find out could save the cameraman a lot of embarrassment, and since you and the camera-man probably work together a lot for a number of video clients...

Batteries

Just about everything on your soundcart operates from batteries. Nagra recorders use 12 "D" cells, and will run two to four days. But always have a spare dozen standing by! Power supplies for your mics generally use two 9-volts. Comteks and popular wireless mics also use 9-volts, but some brands may be different. Other equipment will have their own particular battery requirements.

Even if you have AC adapters, it is still better to run off of batteries in order to avoid the risk of AC induced noise. The same principle that lets the "plug in to any outlet" intercom upstairs in the baby's room be heard on the intercom

downstairs in the living room applies to professional recording. Noise travels along electrical wiring, even when the outlets are on different circuits.

Never buy batteries on sale. Batteries get put on sale when stores have too many of them, and they have been sitting around in warehouses too long.

Purchase all of your batteries from a reputable supplier. Check some of the batteries at random with a digital voltage meter to insure that they are fresh and putting out full capacity.

The industry has found that overall, the Duracell brand of batteries seems to be the best. Also, their two-color design makes it easy to orient the batteries correctly, even in dimly lit environments.

Used batteries should be tossed away immediately. Don't put them back into original boxes or even store them near your equipment, lest someone mistake them for new. A number of Sound Mixers give small BAGS (never the original boxes) of used batteries to other members of the crew for use in non-critical equipment such as flashlights.

Sundries

Other items that you will need include: rolls of 1" cloth camera tape (white, black, and perhaps colors); 2" cloth gaffers tape; 1" surgical tape; rubber bands; safety pins; marking pens; printed sound reports; spare flashlight (to replace the one you will loan to someone and not be returned); spare pocketknife; spare mini-tool kit; Static Guard spray; ACE bandages; alcohol prep pads; canned air; TF Solvent; cheesecloth for wind protection; moleskin; acoustafoam; velcro; condoms for waterproofing mics and wireless; and perhaps even handcuffs & chain for securing equipment cases from being quick-snatched.

Dealing with Rental Houses

As I have mentioned before, I do not trust Rental Technicians when it is my career on the line. Double-check and prep everything carefully!

Place your order with the Rental House early, at least a few days in advance. If you have a shoot coming up, but it has not yet been 100% confirmed, let them know this. They can pencil your order in tentatively, and then check in with you later to verify a firm commitment.

The worst thing that you can do is to march in to a rental house and expect them to drop everything and assemble you a complicated package right on the spot. For your own sake, give them some advance warning!

Be very specific when you order. General terms such as Stage Channel are fine when talking with producers, but have little meaning in a rental house. Tell them exactly what you want, and itemize every accessory and adapter cable that you envision needing. Take nothing for granted in terms of assuming that the technician knows "all about that stuff"—unless you are familiar with the technician personally and have dealt with that person before!

Always write down the name of the technician that you are dealing with. Yours may not be the only order; nor may there only be one person working in the rental department. For that matter, make sure that both of you are clear on what name the order is reserved under (your personal name, the company name, or the name of the production itself).

You would not expect to walk into a strange bank and walk out with fifty thousand dollars in cash without a lot of credit checking. Do not assume that rental houses are any different. Establish an account with them well in advance of the date you need the equipment. Their credit check is not to guarantee that you'll pay them the fifty bucks for the rental of the Nagra, but that their ten thousand dollar recorder and you aren't just going to disappear!

Sometimes, the rental can be billed directly to the account of the production company hiring you. Personally, I prefer to do business that way when I can. If the equipment rental is on my account, and the production company decides not to pay when they are supposed to, then I am stuck holding the bag. They owe me, but I am the one owing the rental company!

If you are acting as the "agent" of the production company—in other words, doing the ordering and picking up of the equipment, but not financially responsible—make sure that this fact is clearly understood by the rental house. Do not let them confuse your personal rental account with that of your client or employer.

Insurance on all equipment is mandatory. All equipment must be insured at "full replacement value" by the insurance carrier, with the owner of the equipment (in this case the rental house) listed as the "loss payee" (the check would go directly to them).

Proof of insurance must be provided to the rental house in the form of a "certificate of insurance". This certificate comes direct from the insurance company itself, and must be requested in advance so as to be received by the rental house before the day of equipment pick-up. The advent of the FAX machine has made this process a whole lot easier and quicker.

Note that this is a special BUSINESS INSURANCE (from *Entertainment Insurance* category brokers), and is not included with typical homeowners or automobile policies. However, some companies can add special riders to Business or personal policies for equipment coverage. Ask your agent.

On large productions, the production company will have their own insurance policy covering all of the equipment. Professional freelancers will also tend to have their own blanket insurance policy, covering rented equipment during the year.

Insurance is available from several major companies specializing in motion picture or entertainment industry services. Check your local film/video trade directories for listings, or ask the rental house.

Some rental houses also offer house insurance, which is billed as a surcharge to your rental. It is usually billed as a percentage (e.g. 10%) of the daily rental fee, multiplied by each calendar day that the equipment is in your possession. Calendar day means that you have to pay the insurance even if it is not a billable rental day (such as a holiday, or a long-term discount).

Rental rates are based on the "daily rental". A daily rental is a one-day rental. You can pick up the equipment late afternoon the day before (since shoots start early in the morning), and can return it in the morning of the day following the shoot. So, for a Wednesday shoot, you could pick up the equipment Tuesday afternoon and return it on Thursday morning.

If the rental house is closed due to holiday or weekend, you do not pay since you could not have returned the equipment on that day. It is also "assumed" that neither you nor the drivers from the production company are working.

Friday afternoon to Monday morning (a Saturday rental) would only be billed as a one-day rental. A sneaky person could claim they were shooting on Friday, and Thursday afternoon to Monday morning would only be one-day. But don't abuse it—rental companies aren't stupid and may not want to rent to you in the future.

A week consists of any seven consecutive calendar days. Most rental houses offer a discount in that you will only be billed for an "XXX-day week". Most common is the "four-day week", although some houses offer "three-day" and even "two-day" weekly rentals on equipment that is hard to rent. However, as long as a holiday or a weekend does not reduce the number of available working days to below four days, you will still be billed at the four-day weekly rate.

Some rental companies offer additional discounts for long term rentals. For some, long term means four weeks; for others it may mean six weeks, etc. Ask your local rental house about their definition of and discounts for long term rentals.

Ask about travel days, rain days, and shipping. Travel days are days that the equipment is in your possession, but not being used because the gear is in transit. On long term rentals, these days may be gratis; on short term it is negotiable at the time the order is placed.

Rain days are days when the production is postponed due to inclement weather. You must call in the morning of a rain day; you may be asked to return the equipment for the day to avoid rental charge, or a discount may be applied via

phone. Again, these things must be negotiated in advance.

Shipping charges are normally paid for by the renter. It is usually far cheaper to ship one-day air and pay more for shipping but save on the rental. Some rental houses will charge you for a rental day even if the equipment is in transit. Sometimes, they will split the difference: not charge you on the day that it is shipped out, but you continue to pay rental while it is shipped back.

In the event of equipment malfunction while out on location, contact the rental house as soon as possible and inform them of the problem. They may be able to trouble-shoot the repair over the phone, or may be able to send out a replacement to you right away. Or maybe not. (Production Mixing is the art of creative problem solving.)

However, do not expect to receive a discount or credit for faulty equipment—unless you alert the rental house within 24 hours. (How are they to know whether the radio mic that you rented broke down on the first day, or worked great for 13 days out of a 14 day shoot?) The rental house may opt for you to return the equipment for a replacement, return the equipment for a credit, or just hold onto it until the end of the shoot.

Working up a budget

How do you respond when a producer wants to know how much is good sound going to cost?

Assume that this is a medium budget, corporate production, being shot on film. Non-union.

Let's start with a crew.

The Mixer works for $400 per 10 hour day. Time and one-half for every hour beyond ten.

The Boom Operator ("Yes, I have someone in particular who works with me") gets $275 for 10.

Since this is low-budget, we will not hire a Utility Sound Technician.

For an equipment package, let's go with a basic Location Channel at $250. Or, if the shoot is local and not far from a rental house, we could budget for a Stage Channel at $175.

Even if the Sound Mixer owns all or part of an equipment package, a production should be budgeted the same as if it were all being rented. Because it is. If not from the rental house, then from the Mixer. Equipment costs money to purchase and maintain, and the Mixer is entitled to recoup that. As for giving the production company an extra discount for privately owned gear, the Mixer should counter by pointing out that privately owned equipment is in better condition and better stocked with adapters & accessories.

Radio mics (four) will run around $175. Perhaps we can get by with only two, at about $100.

Comteks will be useful for the Director and Client. Add $65.

Four walkie-talkies, at $20 per week each, is $80.

Tape stock and batteries will be billed on an "as used basis", approximately $30 per day for stock and $25 for batteries.

Camera tape, canned air, and marking pens will be provided by the production company.

Add another $10 per day for incidental expendables.

Totals for sound: a lot!. Of course, that figure will go down if the shoot goes beyond four days, since the equipment is billed on a four-day week. Salaries remain the same, though. Costs could have been reduced by eliminating the Comteks and going with a Stage Channel instead of a Location Channel.

Nobody said that filmmaking was inexpensive.

Oh, could I recommend any good, cheap soundmen? Well, I know a lot of good soundmen, and I know a lot of cheap

soundmen, but I don't know of any GOOD AND CHEAP soundmen!

CHAPTER SUMMARY

Good production sound does not happen by accident. It requires the concerted efforts of the entire production company, both on the set and particularly during pre-production planning.

Scout your locations carefully with regard to sound. When evaluating a potential location, scout it on the same day of the week and same time of the day that you intend to shoot.

Select your Sound Mixer with the same care that you take when choosing a Director of Photography; don't just assign the critical job of sound recording to "anyone who isn't busy".

Members assigned to the Sound Crew should not be expected to do the work of other departments, unless everything that needs to be done for sound is complete and they are merely sitting idle.

Hire, or at least pick the brains of, an experienced professional Sound Mixer. Consult with the Mixer early on, so as to be able to take advantage of budget and production suggestions. In the long run—even though an experienced mixer will cost more up front—their experience and ability can save valuable time and money in post-production.

Be wary of advice from Rental Technicians. Not being experienced in the ways of production, their suggestions may be rooted in guesswork or rental profit.

Take a professional approach. Do it the best you know how, or don't do it at all. They do not run apologies during the dailies; and your reputation will hinge on what they hear in the soundtrack.

The basic production sound crew consists of the Sound Mixer, the Boom Operator, and the Utility Sound Technician.

Equipment selection and prepping is the responsibility of the Sound Mixer, regardless of who the equipment is being billed to.

Use only the best equipment available on the market. Be prepared as much as possible for contingencies and changes in the shooting schedule.

Use condenser mics and a mixing panel.

Equipment should be meticulously checked before leaving the rental house; and at least a half-day before the start of the shoot to allow ample time for repair/replacement.

Types of equipment packages include: One-Mic Channel; ENG Mic Channel; Stage Channel; Location Channel; Timecode Channels; Video Mic Channel.

Accessories to the basic packages include: wireless mics; Fisher boom; sync playback; time code Nagra w. electronic slate; Comtek wireless audio feeds; and walkie-talkies. Expendables include: recording tape stock; batteries; and assorted sundries.

When dealing with rental houses, establish accounts and place orders in advance. Be specific when you order. All equipment must be insured. Ask about discounts on weekly and long-term rentals. Ask about travel days, rain days, and shipping policies.

PRODUCTION SOUND: An Introduction

Production Sound Mixing is the complex craft of recording live dialogue and sound effects on the set during principal photography of a motion picture or videotape.

It differs greatly from post-production Re-recording and most other audio recording arts in that the Mixer is no longer the key figure in the operation. On the set, the Production Mixer is only one of many important craftspeople involved in the making of a film or videotape. The production company is not out there to shoot an "audio"! Sound must do their thing in harmony with the priorities of camera, lighting, and dramatic direction; and must often take a back seat to these other aspects.

A large percentage of Production Sound Mixers are not bona fide Engineers from an electronics standpoint. Very few Production Mixers possess more than the most rudimentary knowledge of audio circuitry. They know how to operate their equipment, but it is not professionally necessary to be able to perform any sort of extensive repairs. (Technicians back at the sound shop do that.)

What Sound Mixers do have to master, in addition to their own craft, is an understanding of the crafts and techniques ADJACENT to theirs. One cannot choreograph booms and fishpoles without understanding lighting, lenses, and camera moves.

Creative decisions regarding the soundtrack itself cannot be made without an innate familiarity of the entire editing and re-recording process. For example, knowing when the (bad) sound on a wide master shot can be replaced with the good (though not lipsync) track borrowed from a crisp, close-up.

Set etiquette is very important. Shot numbers must be gotten from the scriptperson (and confirmed with the camera assistant) for keeping accurate logs. Communication chains between talent, director, and camera must be assertive yet not overbearing. And rigging microphones under a shy actress' costume requires the utmost tact.

Filmmaking is a COLLABORATE ART; Production Sound Mixing is a part of that.

STAFFING

The typical Production Sound Crew consists of two to five persons, two or three being the norm. The Mixer is the key figure and assumes responsibility for the soundtrack and the politics of the department. Side by side with him is the Boom Operator. The Mixer and Boom man will often collaborate on determining mic placement. Features and television will have a third person, known as the Utility Sound Tech. Duties of the third man include rigging plant mics and radio mics, wrangling cable on complex moves, or working as second Boom. Scenes being shot to sync playback may require the addition of a skilled Playback Operator, as well.

Why this mention about Crewing? Because the number one cause for good studio engineers falling flat on their faces when asked to go out on a shoot is that they think (or the producer thinks) that one man can do it all. Low budget videotape shoots are notorious for expecting one-man audio crews to bring back "Hollywood" finished soundtracks.

The typical duties of a one-person crew may include operating a recorder, mixing the incoming mic levels, and holding the boom—ALL AT ONCE. Sorry folks, it just doesn't work if you're aiming for anything better than an ENG soundtrack.

There are two types of sound that a one-person crew can be expected to successfully achieve: 1) ambience; and 2) talking head.

Since a mic on a camcorder is usually several feet away, it becomes difficult to position the mic close to the source of the sound. Even the best condenser shotguns won't discern most dialogue from those (camera) distances, so the best that a camera mic can be expected to deliver is general background ambience.

As an alternative, lavalieres can be deployed to capture specific dialogue. However, hardwired lavs are rarely suitable for more than interviews, spokesman standups, or limited drama. Radio mics can provide greater talent mobility, but have the drawbacks of RF interference and dropout. Lavalieres in general may create a problem with audio perspec-

tive (the intimate, close-up sound does not match the camera angle). There are also the inherent problems of clothing noise and body movement.

A two-person sound crew would be able, on the other hand, to record all but the most complex dramatic scenes. Because the Boom Operator is a separate entity, he or she is free to move in close to the sound source and to follow talent, enabling better dialogue recording. The Mixer is now able to divert full attention to mixing the incoming signals. Even when talent is placed on a lav or radio mic, the boom person can round out the track by miking the subtle detail, such as footsteps, hand props, and other natural effects.

EQUIPMENT

It should go without saying that the right tools are a necessity for doing a good job.

Start with a lightweight, very mobile, location sound cart. Unlike the studio Engineer, the Production Mixer does not try to isolate himself from the action. Instead, he will park his cart on the edge of the set in full view and earshot of all of the action. Audio monitoring is off of professional grade low impedance headphones or ear wigs.

The sync recorder may be anything from a reel-to-reel Nagra (either a 4.2 mono or IV-STC two-track) to a multi-track digital. Always try to monitor out of the record deck rather than the mixing panel, in case of RF interference or ground loops.

The mixing panel is of paramount importance. On a set, it is not so often a question of mixing a large number of inputs as it is being able to exert control over one or two. A good panel should offer four to eight inputs (rarely will you ever need more than that), limited equalization, lots of input gain, and a communications module.

EQ is hardly used, except for bass roll-off and a slight mid-range boost to help punch the dialogue. Anything more than that is best achieved during post-production. Signal processing does not belong on the set; it should be done later on in the “million dollar rooms” during final re-recording. Films are shot out of sequence, with shots being torn apart and edited together to create finished scenes. Attempts to prematurely process the track can cause a myriad of matching problems.

Much of production mixing consists of riding gain on a mic, leveling out the extremes of each character as well as balancing between multiple characters. Smooth ramping or slope is essential in a pot or fader to accomplish this feat inaudibly. Most of the compact sized ENG-style mixing boxes fall short for this function. Not only are their mini-knobs too small for human fingers, but even slight gain adjustments call attention to themselves on the track.

In terms of the communications module, a mixing panel should have a slate mic (possibly with sub-tone slating if one is working in film), a talk-back for communication with the boom man during a take, audio returns for the boom men, and a 1-K tone oscillator for setting reference levels.

Battery operation of the panel and recorder is imperative. Not only is clean AC often hard to come by on a set, but Nagras have opposite ground and may blow up if the case makes contact with something passing a large differential. If you are working in video, then be very cautious of all electrical connections (VTR, monitor, and camera) that may cause ground loops and induce noise into the track. (Note: electrical interference can be induced via BNC video connectors; not just power or audio.)

Microphones should be of true condenser type, T powered or Phantom. Good shockmounts and blimp-type windscreens are a must. Patterns should include an ultradirectional “long shotgun”, a hypercardioid "short shotgun", and a wide cardioid for reducing echo.. Avoid being saddled with the less expensive, electret condenser capsule systems that are so much in vogue with the video people. These systems, though wonderful for their price, lack the sensitivity and reach offered by “real” condensers.

Lavalieres come in two basic varieties, transparent or proximity oriented. Up until recently, all of your professional grade electret lavalieres were proximity oriented. That is, they tended to add presence to close dialogue while rejecting background ambience—which was fine for newscasters and spokesman. Some of the newer mini-lavalieres offer a more transparent sound, allowing them to blend in more naturally with overhead boom mics or to function as plant mics. The drawback is that the transparent lavs also pass more ambience. Depending on the situation, both varieties have their uses.

Radio mics are an option. They are relativley expensive, and even the best of them can be unreliable due to outside factors (such as RF interference, magnetic voodoo, etc.). However, there will be instances when the sound is either gotten off of radios or not at all. If you plan on having radios, budget for more units than what you expect to use. Otherwise, what do you do if a unit breaks, or if there is interference on a given channel?

Fishpole selection is very important. They should extend to 12 or 18 feet. A pole should be lightweight, but not to the point of bowing under the weight of a mic, shockmount, and windscreen at full extension. Struggling all day with a bending fishpole will wreak havoc on a boom man's back.

Studio booms, such as the Fisher, are actually rather inexpensive to rent and should be seriously considered for many non-documentary productions. Their ability to telescope over distances and cue make them highly versatile on a set. Budget extra, though, for an experienced boom operator to run it.

PRIORITIES

As mentioned before, Production Sound is an art of compromise on the set. Dialogue is recorded with Picture, and both must give way a little bit.

The job of the Production Mixer is to record raw material for the editors and re-recording mixers to transform into a finished soundtrack.

Therefore, the first priority is to get the DIALOGUE any way possible that would be usable. In the event that laying down usable dialogue is impossible, then one should still try to get as near perfect a track anyway, even if it is only to be used as a guide track for ADR (looping).

Second priority would be to record the Dialogue in matching PERSPECTIVE for the camera angle.

The final priority is to record SOUND EFFECTS to accompany the shot. This might include such things as footsteps, hand props, doors, etc. Sometimes this is recorded during the actual take, during a rehearsal, or after the shot. Some productions may also ask for Presence (room tone).

Hint: If you are requested to record Presence, arrange to do it just before the camera roll of the first take. That way, everyone is in position and the sound will be an exact match of the actual take. Waiting until the end of the last take results in having to fight the commotion of exiting talent, crew, and wrapped equipment.

Recording these effects can be the most trying from a political standpoint. Editors like sound effects, but on isolated tracks. Producers, on the other hand, are impressed by sync sound effects on the main track during the screening of dailies. Production Managers hate anything that slows up the pace of things on the set, even if it would save money later.

It is essential to determine how the show is going to be handled from an editorial standpoint. For instance, most non-theatrical videotape productions do not have a budget for extensive audio sweetening, other than to lay in some music, narration, and a few key sound effects. In that situation, a good mixer might try to pack his track with as much texture and live sound effects as necessary, without endangering either the clarity of the dialogue or the ability to intercut shots. On the other hand, a feature film editor would prefer a "clean" soundtrack that can be embellished on the cutting bench.

MICROPHONE TECHNIQUE HIERARCHY

There are four basic ways to approach miking a subject: boom; plant; lavaliere; or radio mic.

In most instances, the best dialogue will be achieved by employing a fishpole or boom overhead of the subject. A good condenser, angled a couple of feet and slightly ahead of the subject will produce a crisp, natural tone. The sound will not be affected by clothing noise or bodily movement (such as arms folded across the chest). Talent can move around, walk, sit, etc.—with the mic following overhead. Multiple performers can interact with each other, both verbally and physically, without rustle or phasing problems.

In a pinch, the fishpole can be held at knee level with the mic pointing up.

There is no difference (to the mic) between a fishpole that is not moving and a C-clamp. Fixed microphones, also known as plant mics, can be strategically deployed around the set to cover isolated characters that would be impractical to reach with the boom.

Plant mics can consist of either regular condensers or suitable lavalieres. The new mini-lavalieres, with their great sensitivity and transparency, make excellent plants. They are so tiny that they can be hidden right in the middle of the scene and not show up on camera.

Plants can be hidden in doorways, on executive pen sets, on the edge of dressing mirrors, bed headboards, automobile sun visors, even in floral arrangements!

Employ shockmounts to avoid noise and vibrations from being directly conducted to the mic. On lavalieres, a small loop of tape works nicely.

Pay strict attention, though, to multiple mic phasing. A plant and a boom overlapping can easily result in mush, unless you keep your hands busy on the pots.

Lavalieres are the next option. Worn on the body, they tend to go (or stay) where the actor is. As mentioned earlier, the proximity oriented mics (e.g. Sony ECM-55 & ECM-44) tend to add presence to the dialogue as well as to reject background noise. Transparent sounding lavs (e.g. MT830, MKE-2, Tram) blend better with overhead condensers and sound more natural or less “forced”. On the other hand, they do not screen out background ambiance as much.

If the actor is going to be walking, and a cable dragging from his or her ankle is impractical, then radio mics are the final resort.

SELECTION OF OVERHEAD MICS

Which pattern of condenser is best? Like everything else, it depends on the situation.

Narrower patterns, such as shotguns, have greater reach but exhibit more reverberation in a closed interior. For that reason, shotguns are preferred for exterior use or sometimes for use in a very dead soundstage. Besides a build-up of echo in an interior, a shotgun used overhead tends to be physically unwieldy in terms of headroom. Their narrow pattern also makes cueing from actor to actor very critical.

Shotguns, like telephoto lenses, will compress the background in terms of the foreground. In a photo, a distant sunset will appear very large and very close to a foreground sailboat. Similarly, shotguns will magnify background sounds and ambiance in relation to the subject. That is why the best way to utilize a highly directional microphone is with nothing behind the subject (i.e. the mic looks down at the subject, ‘seeing’ only quiet dirt past it; or aimed upwards at the subject, seeing only silent sky). Aiming a shotgun horizontally should be avoided, except for miking certain sound effects.

Wider pattern condensers (cardioids) provide the mellowest sounds in terms of reverberation or room echo, but also have the shortest effective range. They must be kept relatively close to the actors in order to isolate the dialogue. However, since the cardioids are often used in cramped interiors with low ceilings, excessive head room is not usually a problem!

In between the wide cardioids and the narrow shotguns are the wide hypercardioids and the narrower hypercardioids. Their selection would be a trade-off between mellowness versus effective reach.

In addition to echo and reach, another factor that comes into play when selecting a boom mic is that of spread. Scenes involving tricky blocking and/or multiple actors might be better served by a mic that does not require as critical a targeting, even though it would be a compromise against reach and punching the dialogue.

One very useful trick in balancing a strong voice against a weak voice is to take advantage of the microphone’s natural pattern. Favor the weak voice on axis, and let the strong voice strike slightly off axis.

A word about wind noise. Foam slip-on windscreens should always be used on interiors, since condensers are sensitive to even the most minute air movements. Out of doors, use a zeppelin style or furry windscreen (Rycote or

Lightwave). Wind tends to gust unexpectedly, and simple foam is ineffective against anything more than a wisp of a breeze.

Handheld microphones (performer or reporter mics) aren't used very frequently in theatrical production, but can have their uses. Dynamic mics are ideally suited for recording loud explosions, since their elements are virtually indestructible. A dynamic mic used relatively close-up (6 to 9 inches away) works excellently for isolating speech from a noisy background, such as for on-site voiceovers or talking head (mic seen on camera).

Staged scenes involving the use of a handheld mic (as a prop) should be recorded exactly that way, "as a prop"! Use a boom mic to actually record the voice, unless you want to be at the mercy of handling noise and inconsistent mic placement.

For man-on-the-street reporter interviews, provide talent with an omni-directional condenser (or electret) microphone. That will give you some consistency, irregardless of how well the reporter pays attention to cueing the microphone between himself and the interviewee.

LAVALIERE USE

Correctly rigging body mics on talent requires time and tact. For at some point during the process, the soundperson will have to work inside of talent's clothes.

The microphone capsule itself can be secured either outside of clothing or hidden under wardrobe; the cable and connector will almost always be routed under wardrobe.

If the mic is going outside of clothing, then mounting clips can be used. The proper technique for using the tie-clasp style clip involves looping the cable from the head of the mic, like a "J", through the bend (hinge) of the clip. The cable continues up and around—behind the garment—to complete the circle. As the cable makes its way down, it is clenched in the jaws of the clasp, thus providing a strain relief.

The remainder of the cable is run behind clothing so that the XLR connector can be secured at a convenient point, such as at the waist (belt or pocket) or ankle. Regular mic lines can then be easily connected or disconnected so as to free up talent in between takes.

If needed, the external lavaliere can be made quite inconspicuous by camouflaging it to match wardrobe. Colored marking pens can be used on small strips of tape and/or foam windscreens to subdue the appearance of the mic head and clasp. Alternatively, small patches of felt or cloth can be used to cover the mic. Remember that the (camouflaged) mic will be so tiny in the frame during a medium shot as to be nearly invisible. On close-ups, the camera can frame the microphone out completely.

A useful trick is to save the foam-tipped tech swabs used for head cleaning. These foam booties make excellent, expendable windscreens for mini lavalieres.

Hiding a lavaliere completely under clothing requires a lot more care and attention.

There are two types of clothing noise that one can encounter: contact and acoustic.

Contact clothing noise is caused by a garment flapping into or rubbing across the mic capsule. The solution is to carefully immobilize all clothing that may create this problem, by taping down everything on either side of the mic. One popular technique is to sandwich the mic in between two sticky triangles of tape (formed by folding a strip of tape like a flag, sticky side out). Contact noise can also be caused when clothing rubs against the mic cable, so care should be taken in this area also—even for external lavalieres. Form a loop near the mic for strain relief, and then apply a few lengths of tape to along the cable. Use double faced tape or sticky triangles to immobilize clothing as necessary, to keep it from rubbing.

Acoustic noise is that created from clothing rubbing against itself and generating a sound. Static Guard^{tm} works well against this. A light spray of water can help soften starched fabric. Synthetic fibers tend to be much noisier than naturals, so they should be avoided whenever possible.

Rigging radio mics is a complex art in itself, but the most important point to remember is to never allow the mic line and the antenna to cross. Also, the antenna should be kept somewhat rigid, and never looped over itself. If the antenna has to run in a direction other than straight up or to the side, flip the transmitter unit around. (It is okay for the mic line to loop around, though.) A good way of keeping a longer (VHF) antenna rigid is to affix a rubber band to the tip, and then to safety pin the rubber band to the clothing. This maintains a little tension but still provides a safe strain relief if the actor should bend over.

Check talent regularly. Tape tends to loosen due to moisture and movement. Costumes tend to be adjusted constantly, either by talent themselves or by the costume department.

Never assume that wardrobe personnel know how to rig either lavalieres or radios. Consult with them in terms of costume selection or modification so as to facilitate microphone and/or transmitter placement, but do not leave the actual wiring up or readjustments to them. Costumers worry about how the actors look, not how they sound.

SYNC PLAYBACK

The key word here is sync. To have performers dance and mouth lyrics beat for beat with a prerecorded track requires 100% sync at all production and post-production levels.

A master soundtrack is created, and recorded with a sync reference (SMPTE time code). This track will generate the final version soundtrack that will be used by the editor in the finished product. Generated from this (final version) soundtrack will be two or more playback dupes, for use on the set.

On the set, the playback dupe is resolved and played back at proper speed (which may be 0.1% faster than the master). The track is either amplified through a speaker system or silently broadcast to the performers via induction loop cueing. The camera films at crystal sync, sound speed. Timecode from the playback deck is displayed at the beginning of the scene via a Denecke timecode slate, so the editor can match up the segment of music with the appropriate picture.

None of this will work, however, if any of the following conditions exist: 1) the playback dupes are not a frame-for-frame exact copy of the master soundtrack that will constitute the final edit; 2) the playback dupes are not resolved and played back at correct speed (which may be 0.1% faster than the master); 3) the camera does not run at crystal sync speed; 4) talent is out of sync due to poor acting. Sync playback is a complicated process. Don't attempt it on your first time out.

IN CONCLUSION

Production Sound is not an endeavor to be taken lightly. Electronic knowledge and a mastery of studio (music) techniques are not qualifications in themselves for successfully mixing dialogue on a shooting set. Life in the Recording Studio is based on achieving excellence under controlled conditions. Mixing on a Production Set is a matter of generating usable raw material, in what are usually uncontrollable conditions.

But with the right approach, equipment, and trained personnel—a Production Mixer can achieve excellence.

The Hierarchy of Mic Techniques

Achieving clear, crisp dialogue and sound effects on a film or video production is no easy task. Production Sound Mixing is a craft that requires a blend of technical expertise and proper tools.

The key to good sound gathering is to work from some basic strategies, and then work up from there.

Anticipate instead of react. Don't limit yourself capability-wise to what you have been led to expect based on the production meeting. Things often change at the last minute, and producers/directors are notorious for not bothering to inform all of the crew. Be prepared for as many contingencies as possible. For instance, if the shooting schedule calls for only interior interviews that day, I would still bring along a good exterior shotgun mic and windscreen just in case someone decides that a long "walk & talk" against a scenic city background is visually more interesting than a talking head in a cramped office.

Think in terms of what is known as the Hierarchy of Microphone Techniques. This hierarchy serves as your starting game plan in approaching a scene in terms of microphone selection and utilization.

Here is a summary of the Hierarchy:

1) Overhead boom.
2) Boom from underneath.
3) Boom mics as plant mics.
4) Lavalier mics as plant mics.
5) Lavalier mics as body mics.
6) Lavalier mics, as wireless or radio mics.

Now, let's examine these options in detail.

1) Overhead miking from a fishpole or studio boom is the most favored technique in the feature/TV/commercial industry. It is probably the best choice 90% of the time.

Generally, overhead miking will yield the most natural sounding dialogue with the least amount of mixing and editing effort.

It provides a pleasant blend when there are multiple actors involved. Two, three, even a small group of people interacting can all be recorded from a single mic.

A mic on a fishpole or boom allows for a fair amount of physical activity and movement by the talent. Actors are free to enter and exit a scene, move around, jump around, climb around, etc. There are no trailing mic cables to inhibit their range of motion.

An overhead mic will pick up sufficient sound effects, footsteps, and hand-prop noise to give the soundtrack a full texture. Because the faces are closer to the mic, dialogue will dominate the track, but other sound effects will still be audible.

Audio perspective is easier to maintain with an overhead mic. On a wide master shot, the mic tends to be higher so that the resulting dialogue seems thinner and more "distant". On close-ups, the mic can be lowered giving the sound much greater presence and "near-ness" to the screen.

But what if there are physical obstructions in the set that prevent deploying a microphone from overhead?

That brings us to the next option: 2) Boom miking from underneath. The boom mic can be fishpoled up at the talent from knee, thigh, or waist level with good results. The sound will be slightly more bassy than miking from overhead, but still quite usable and acceptable. Note that a mic aimed up at a person tends to pick up more of the chest cavity, thus accounting for the increase in bass.

Personally, I find that it is much more difficult to boom from below, due to the presence of set furniture or the choreography of foreground persons. Camera operators also have to be much more careful, since it is more likely to widen the frame to show more of an actor's torso than to show more empty headroom above. Never-the-less, there will be many shots where miking from below is the simplest solution.

If the overhead microphone does not have to move, does it make any acoustical difference whether the mic is held up by human hands with a fishpole or rigged to a C-stand or clamp?

The definition of a **"plant" mic** is any mic fixed in place on a set. It can be a boom mic secured by any imaginative or convenient means over a dialogue mark. Or it can be a boom mic secured in an "underneath" position, such as behind a table or potted tree. Or it can be a miniature lavalier strategically attached or hidden anywhere in the set.

Which type of plant mic you choose depends on the situation you are faced with.

Let's say you are covering dialogue of two actors in a room and a third actor pokes his head into a doorway and delivers a line. Your two key actors are probably being covered by a handheld fishpole. The doorway could be easily miked either by a boom mic positioned above the door arch with a clamp or C-stand. Another choice could be to tape a lavalier to the inside of the door frame.

A telephone booth can be readily miked by hiding a lavalier onto the surface where the caller will be facing.

A desktop can be miked by hiding a lavalier on a pen set or a rollidex. A restaurant table can be miked by sticking a mic into the floral centerpiece. (Okay, cue the "plant" mic puns.)

To mic an automobile, merely attach a lavalier to the sun visor. Determine to which side the actor/driver will be speaking, and cheat the position of the plant mic to accommodate that.

A microphone on the visor is preferable to using a mic on the actor's body. A body mic would give you lots of clothing rustle, seat belt rubbing, and other noise. On the visor, it is completely clean. Being high up in the vehicle, the mic is distant from road noise (gravel striking the underbelly of the car), as well as less susceptible to engine rumble. The padded ceiling of the vehicle reduces sound reflections and echo, and the padding of the visor provides additional isolation.

To cover driver and passenger, put the mic on the visor near the center of the car. If the passenger has a much weaker voice than the driver, place the mic on the center-facing edge of the passenger's visor. Or, if the driver faces forward most of the time, but also has a line or two directed out of his window, cheat the position of the mic to the far left of this visor. If necessary, use two plant mics to cover driver's window, driver front, passenger front, and passenger window. A second or third mic can be used to cover dialogue from the rear seat.

Be imaginative in your mic placement, but don't overdo it. Let one mic do as much work as possible; multiple mics in close proximity to each other will interfere with each other, creating echo and a tinny sound.

One caution about planting mics around on the set. They will only be effective if the dialogue is directed in their general direction. A plant mic that is behind someone's head won't be much good. Also, their range is limited; don't expect miracles. This is filmmaking, not surveillance. What works fine for a stake-out may not be acceptable in a professional sound mix.

Next in our bag of tricks is the lavalier used as a body mic. Lavs tend to have three major problems: perspective, clothing noise, and mobility.

Perspective is the biggest problem. Dialogue recorded with lavs usually sounds like dialogue recorded with lavs. Talent always sounds like they are close to the camera, even in long shots. If talent turns their heads over one shoulder, their voice drops off. If talent leans over a hard podium or tabletop surface, their dialogue suddenly becomes infused with reverb.

The lav sound is sterile and somewhat free of natural sound effects and ambiance. The result is more authoritative and reporter-ish, less slice-of-life. Depending on the effect you are looking for, this could be a plus or a minus.

For example, an instructor will sound more dominant on a lavalier. But a community relations spokesperson will sound warmer and more natural if miked with an overhead boom.

Perspective can be improved by using some simple cheats. Place the lavaliers further down on the chest or further away from the voice to "open" up the sound. Two people standing close to each other and can be miked off of each other's mics to increase the air space.

Be aware that the audio characteristics of lavaliers vary from make and model. Some lavaliers are more reporter-ish, and others are more natural. Some reject background noise and focus on the individual, and others reach out to include other elements in the scene.

A boom mic on the set can be used to record footsteps and sound effects that the lavs might ignore. Recording just a smidgen of ambient "noise" (open the mic channel just a little bit) will wash out the normal sterility of the lavaliers. Use more "mic bleed" in long shots to thin out the dialogue, and then reduce the mixture for close-ups.

Clothing noise is a major problem with lavaliers. Although we don't have the space in this article to fully explore that area, one simple solution to clothing noise is to avoid the problem by attaching lavaliers to non-traditional sites, such as a hat brim or a clipboard.

When lavs do have to be hidden under clothing, secure the clothing carefully on all sides of the mic head. If the clothes are taped to the mic, then they cannot rub against the mic. Any loose flap of clothing that could strike the mic should be secured with tape or pins. Break the stiff starch near the mic with some water, so that noise does not conduct to the mic. The use of StaticGuard can also help reduce clothing friction.

Mic cables should be connected at the ankle. Never let talent drag the power supply of a lavalier by the thin mic cable that attaches it to the capsule. Instead, secure the power supply to the leg (put it in the sock, or use an ankle strap, or line the ankle with a protective strip of cloth or toilet tissue and then use gaffer tape). Attach the mic cable to the connector at the ankle, during a take. Remember to disconnect immediately during breaks so that talent is free to move off of the set.

Obviously, there will be situations when it is either not practical nor safe for talent to be tethered by a mic cable. Our last resort as a miking solution is to use radio mics.

Radio mics suffer from all of the limitations of lavaliers, plus those of their own such as electronic failure, radio interference, and bad karma that the scientific types are loathe to admit exist (such as mysterious magnetic black holes). Everything that has ever made your television reception bobble for a moment can interfere with radio mics: appliances, computers, passing trucks, overhead airplanes, CB's, and so on. Radio communications can also be a source of interference: walkie-talkies, mobile radios, repeaters, etc.

Try to use wireless as sparingly as possible. Sometimes, you can start a scene with a wireless, and then go hard-wire after talent has settled into a spot.

Only use fresh batteries, and change them routinely every couple of hours, or sooner!

If you are planning to use radio mics, bring along back-up units for contingency. There may be interference on one channel, or a unit may fail go sour on you, or talent may break a unit accidentally.

Selection and Application of Shotgun Microphones

In the previous article, I presented a general overview of microphone techniques or strategies used in the recording of production sound and effects for either motion pictures or video.

We established a basic game plan to follow when evaluating how to approach a scene. This “Hierarchy of Microphone Techniques:, you will recall, consists of the following:

1) Overhead boom.
2) Boom from underneath.
3) Boom mics as plant mics.
4) Lavalier mics as plant mics.
5) Lavalier mics as body mics.
6) Lavalier mics, wireless.

As stated before, overhead miking from a fishpole (or studio boom) is the most favored technique for film/video production and is the best choice most of the time.

The operational word here is “overhead”. Why?

There is a tendency for filmmakers to rely too heavily on their camera mounted shotgun mics rather than separately mounted boom mics. Obviously, having a microphone on the camera is more convenient. But our objective in the field is not convenience, but obtaining the highest quality sound possible!

Think of your shotgun microphone as a telephoto camera lens. A long lens will isolate and magnify a distant subject, but at the same time it will compress the perceived distance between subject and background. Everything appears to be closer together than they physically are.

The same sort of spatial compression takes place with microphones. The voice of the subject will sound closer, but any noise in the background will also be magnified.

Therefore, the key to isolating voice without background noise is to create a line of sight with the microphone that sees the voice but does not see the background!

To put this in cowboy talk, aim the mic from ABOVE the subject so that the mic points DOWNWARD. The line of sight reaches from the front of the mic, to the mouth, and then towards the ground. Background noise and ambiance will strike the sides of the microphone (which is the maximum rejection angle) rather than striking the mic along its most sensitive front axis.

In the event that it is impossible to mike from above, the next best option is to mike from below, so that the line of sight terminates with sky. Personally, I find that miking up tends to emphasize bass a bit more, since the mic is seeing more of the chest cavity. Also, camera operators are not as accustomed to maintaining a strict lower frame line as they are at watching their headroom, so the mic tends to pop into the shot more frequently.

Another important consideration when booming is not just the angle of the mic but the distance. Shotgun mics are not designed to be used (for broadcast quality sound) at much more than a few feet. One of the great advantages of using the mic on a fishpole, as opposed to being attached atop a camera, is that the mic can be brought close to the subject even when the camera isn’t.

I often tell novice boom operators that they aren’t doing their job properly if the camera operator fails to complain that the mic is in the frame (during rehearsal). Every inch closer that the mic can be to the subject will improve the quality of the sound. Never fly the mic higher than it absolutely needs to be if you want to control echo and background noise. Several inches to a foot over the top of talent’s head is ideal; up to a few feet overhead is okay depending on the situation.

Place a thin strip of white tape on the tip of your boom mic's windscreen to make it obvious in the camera viewfinder. Better for the operator to notice it on the set than for the editor to discover it lurking in the

frame during screenings! To achieve the closest mic placement, always begin with the mic clearly visible in the frame, and then move it outward gradually until it clears the viewfinder. If you began from way out of frame, and gradually moved closer -- the camera operator would probably panic and tell you to stop too far above the frameline.

Some camera operators confuse width with height. A wide-angle lens means wide from left to right; it doesn't mean that they have to reveal several feet of air above the talent's head. A simple tilt-down of the lens will correct excessive headroom in the composition when using a wide angle lens!

Learn to recognize and take advantage of the on-axis (live) and off-axis (deader) angles of your mics. Most shotgun mics are very much on-axis at the front (say, twelve o'clock), and taper off towards the back (six o'clock). But at exactly six o'clock, there is an increase of sensitivity! In other words, the back of the mic does not offer the most rejection to background noise. The most rejection occurs around four o'clock and eight o'clock respectively.

So to decrease a source of noise, you would not want the mic facing directly away from it, as that would only serve to put the noise at the live spot in the back. Instead, angle the mic so that the noise source strikes slightly to the side and rear.

When deploying your mic overhead, keep these angles in mind. Often it is better to compromise the angle of the voice (slightly) in order to keep heavy background noise to a minimum. Any angle of the mic should be consistent with the source of the worst noise. For instance, a person talking on the sidewalk would put the mic overhead, but cheated towards the buildings and away from traffic — even if the camera changes shot angles.

Similarly, a subject walking along the edge of the surf on a beach should have the mic facing inland, not out towards the noisy surf.

Another important factor to pay attention to is "perspective". The distance between microphone and subject should agree with the distance to the screen or camera. In a long shot, it is natural for the voice to sound more distant and for there to be a greater presence of ambiance. Close-up angles should consist of more voice and less background.

However, angle of motion is very important. A person walking away from the camera should not be walking towards the microphone, or vice versa! Novice boom operators are notorious for perching themselves in a safe spot out of the frame that places the mic in a position not consistent with the direction of travel relative to the lens.

A person with their back to camera should not be facing the mic. A person walking up to the camera should not be walking away from the mic.

To balance a strong voice against a weak voice, use your mic angle and placement rather than riding gain (volume) on your mixer/recorder. Let the strong voice strike the mic slightly off-axis and/or from a little more distance than the softer speaking actor. This will balance the relative volume of both people without having the background noise continually changing during the shot.

Let's examine the types of microphones we have to chose from.

Microphones can be defined by two sets of parameters: sensitivity and pattern.

In terms of sensitivity, there are three main categories that a microphone can fall into.

Dynamic: Think of a dynamic microphone as a manual typewriter. The harder that your finger hits the key, the stronger the imprint. With a dynamic mic, the pressure of the sound waves moving the diaphragm actually generates electrical current (which is what the sound signal is). Dynamic mics are extremely rugged and do not require any form of battery powering. They are relatively insensitive to background noise (or feedback) and are commonly used as handheld performance mics and reporter's mics.

A dynamic mic used close to the mouth will reject all but the loudest background noise, making them ideal for stand-up reporting (where the mic can be seen on camera) or narration recording (to eliminate as much background as possible).

Dynamic mics tend to naturally compress loud noises, making them a good choice for recording explosive and crashing sound effects. A loud sound effect, unless carefully recorded, will tend to be "blown" right off of the recording tape, which is why real gunshots that leave your ears ringing only sound like dull pops on a videotape.

The downside to dynamic microphones is that they have very poor reach in terms of distance when it comes to dialogue. They are pretty much useless on a boom or fishpole.

Here's a tip: When filming an actor who is pretending to be a performer and will be seen using a handheld mic, it is much safer to consider the hand mic as merely a stage prop and to mic the actor with a boom or lavalier. Actors in those situations tend to gesture wildly with the mic, making your chances of getting good dialogue quite slim.

The next most sensitive group of microphones are the electret condensers. Electret condenser microphones are like electric typewriters. These microphones operate off of a nominal voltage (usually 1.5 volts) which is derived from an internal battery such as an AA or button battery. The voltage that creates the audio signal comes from the battery (as opposed to being generated magnetically as in the case of dynamics); the relative sound levels control the capacitance, releasing voltage according to what the mic hears. Almost think of it like a meter that measures the sound, and releases a signal accordingly.

Electret condenser mics offer much more sensitivity (range) than dynamics, and include what is commonly referred to as "ENG" grade shotgun mics as well as most lavaliers.

Examples of electret condenser shotgun mics include the Audio Technica AT835b, 815a; and the Sennheiser K6/ME66 (or the older K3U/ME80). Lavaliers include the Sony ECM44/55/66/77, the Tram TR50, the Sennheiser MKE2, and the Audio Technica AT803b & MT830.

The third group of professional microphones are the true condenser type. Think of electronic word processors. Condenser shotgun mics are the most sensitive and offer the greatest working range for Production. Condenser mics require external powering such as 12volt T or 48volt Phantom, which can be supplied by an accessory battery power supply plugged in line between the microphone and the mixer/recorder. Some mixers, recorders, and camcorders offer built-in mic powering.

Examples of condenser shotguns include the Audio Technica 4073/4071; and the Sennheiser MKH416/816/60/70.

A note here on microphone powering, which is an area very confusing to many people. As stated before, dynamic mics do not require any external powering, and plug directly into the MIC INPUT of a mixer/recorder. Electret condenser mics are self-powered (by an internal battery) and also plug directly into the MIC INPUT. Condenser mics require external powering, which can be a battery supply located anywhere along the mic cable path. For instance, the mic connects to a regular XLR cable, that cable plugs into the power supply, and then another short cable connects the power supply to the MIC INPUT.

In all of the above cases, if the mixer/recorder offers the option of mic powering, that option IS NOT USED. The correct MIC INPUT setting would read "dynamic".

Sometimes, we can power a CONDENSER mic directly from the mixer or recorder. In that case, the external battery supply is not used at all, and the mic plugs directly in. A switch near the MIC INPUT should be switched to "48 Phantom" or "T" or "A-B", depending.

Condenser mics come in two basic varieties: 12 volt T or 48 volt Phantom. The designations "12 volt T" and "12 volt A-B" mean the exact same thing, by the way. The difference between T powering and Phantom is significant.

T powering involves sending 12 volts up the mic line along pins 2 and 3 of the mic cable. Traditionally, pin 2 is PLUS and pin 3 is MINUS. Pin 1 is simply used for shield and ground.

Phantom Power uses all three pins to send 9 to 48 volts of powering up to the mic. Both pins 2 and 3 are PLUS, and pin 1 is MINUS. Some mics are advertised as being able to function at 9 or 12 volts Phantom. However, all of the premium condenser mics that I have encountered prefer and are rated for 48 volt Phantom.

In theory, Phantom power should not interfere with the operation of dynamic mics, since the voltage is balanced equally across pins 2 and 3 (which conduct the audio signal). Experience dictates otherwise. Although most dynamic handhelds are not affected, the same is not true of all electronic based mics, such as some wireless.

There is one more complication to be aware of, namely the term “red dot”. In the early days of filmmaking (“b.bc.” or before Beta Cam), people only used Nagra recorders for audio. Because Nagras are positive ground, they were set up with T-powering that was pin 3 PLUS and pin 2 MINUS. To correct for this, most mics intended for film use were modified to match this reversed standard, and were designated as “red dot” mics because a red dot was usually (but not always) engraved on the side. Today, one will encounter quite a number of Sennheiser 415/416/815/816 shotgun mics that are “red dot” polarity. To make them work with non red-dot power supplies, simply use a reversing cable between the mic and the power supply. A reversing cable is merely a short mic cable that has the leads switched in one connector, so that pin 2 goes to 3, 3 goes to 2, and 1 remains connected to 1.

The other parameter by which we classify shotgun mics is by the pickup pattern.

Omnidirectional refers to hearing equally well in all directions. Most lavaliers are omni, which is good since they could end up being worn in different places and at different angles in order to accommodate clothing styles. Omni mics are also preferred for handheld interviews, since this allows for the unexpected overlapping of dialogue between interviewer and subject.

Cardioid pattern literally means heart shaped, and refers to microphones that are more directional from the front.

Hypercardioid or supercardioid are considerably directional. This group includes what are known as “short shotguns” such as the AT4073a and the MKH416/60.

Ultra-directional means extremely directional, such as full or long shotgun mics. Examples include the AT4071a and the MKH816/70.

So which mic to use?

The rule of thumb is that the more directional the microphone, the more it will emphasize echo in a small room. Therefore, reach the best compromise between the reach you need and the mellowness you would like to hear.

Long shotguns work the best for most exterior shots, since theses mics are characterized by long reach and very narrow pick-up. The narrow field of view helps to control background noise if the mic is deployed overhead. The greater range helps because exterior shots are very often much wider than interior frames, since there is more interesting stuff to look at or action to cover. Long shotguns can be successfully deployed up to 8 or 9 feet overhead, depending on the situation.

Always used a blimp windscreen on your long shotguns to guard against wind noise. I find that using a thin foam windscreen inside of the blimp (but still leaving some airspace) gives almost twice the protection. On the very sensitive condenser mics, a furry windsock will help to disperse the wind and diffuse it upon impact.

The new Equalizer windscreen is a mini-zeppelin with integral furry covering that fits over the mic like a foam windscreen, but offers adequate protection against light wind and is considerably less expensive than a full zeppelin rig.

To guard against rain, use lots of ScotchGuard spray. Extreme rain (or fire fighting) would call for a thin condom over the mic itself, as well as a rainhat over the blimp made from what we call “hogs hair” or “rubberized hair”. Hogs hair is a thicket type material that will break up the raindrops and prevent the pitter patter sound of them striking the windscreen, roof of a vehicle, or roof of a recording stage.

Long shotguns may also be used on some interiors, providing that the room or sound stage is very large

and free of echo. They offer the advantage of increased overhead range and headroom on wide shots. Their disadvantage on interiors is: 1) they are physically longer and may bump a low ceiling; 2) they must be precisely cued or aimed because of their narrow pattern (to cover two actors requires a very good boom operator); and 3) long shotguns will exaggerate room echo.

Prime examples of high quality, condenser long shotguns include the Audio Technica AT4071a and the Sennheiser MKH70. There are still a lot of the older MKH816's floating around. For those on a smaller budget, the Audio Technica AT815b and the Sennheiser K6/ME67 are ENG quality shotguns that can operate from an internal AA battery.

Interior locations are usually better off being miked with a **short shotgun**. The short shotgun features a slightly wider pattern and slightly less range, but does not exaggerate the room echo as much. The wider pattern and physically shorter length of theses mics facilitates use with lower ceilings, especially when it comes to covering multiple actors. Condenser short shotguns can be deployed indoors up to 5 feet above the actors (though 2 to 3 feet is better).

Today's favorite short shotgun condenser mics include the Audio Technica AT4073a and the Sennheiser MKH60.

In the choices of electret condenser short shotguns, there are the Audio Technica AT835b and the Sennheiser K6/ME66. Neither mic offers the range (4 to 5 feet) of their big brother condensers, but at shorter distances (up to 2-3 feet) they sound very good on the soundtrack. The main advantages of these ENG shotguns are price and ruggedness. Both mics are the standards of the news gathering industry.

Indoors, all short shotgun mics should always be used with a foam windscreen. Out of doors, a blimp windscreen or half-blimp such as the Light Wave Equalizer or Rycote Softie should be utilized.

In a pinch, simply wrap a few layers of cheesecloth over the foam windscreen, and then cover in a tube-style sweat sock. It works.

Any shotgun mic should always be used in a good shockmount to eliminate handling noise and vibration. The industry standards for short shotguns are the Audio Technica AT8415 universal shockmount (the tic tac toe rubber band mount) and the new K-Tek KSM.

Blimp windscreens require their own brand of pistol grip shockmounts, which are usually purchased in conjunction with the windscreen system. These mounts are intended to be used with or without the windscreen, so there is no need to purchase a separate shockmount if you have a blimp system.

In addition to the long shotgun and short shotgun, Hollywood has begun using a third type of microphone in its quest for perfect dialogue. Some **condenser cardioid** microphones have become popular for their ability to reduce or even eliminate echo in a small room or set!

These mics yield a very rich voice track, are are favored for close-ups and medium close-ups where the overhead mic will not be more than two feet overhead. Examples include the Audio Technica AT4051a, the Sennheiser MKH40, and the Schoeps.

One last point. Make sure that the boom operator can HEAR the soundtrack! In order to properly position a mic both in terms of distance and angle, the boomperson must be able to listen to what is being picked up. Provide a headphone feed either via a wireless (assistive listening) rig or with a long headphone extension cable. On professional sets, we uitilize a special mic cable (known as a “duplex cable” or “boom cable”) that combines an XLR microphone cable with a headphone cable in one housing. This cable conveys the audio signal from the mic to the mixing board while sending a headphone feed back to the boomperson.

Because there are often multiple mics in use on a set (boom, plant, lavalier, wireless) -- the boom operator should be monitoring the entire mix (not only the boom mic) so as to be aware of any phasing problems that would be created by two mics picking up the same actor at the same time.

Tips on the use of your *RoboPole*® Mic Boompole

by Fred Ginsburg C.A.S.

Why use a boompole?

Camera-mounted mics may be adequate for general ambiance and background effects, but they lack the reach and versatility of boom mounted mics. Placing the microphone where the lens is may be convenient but it certainly does nothing to assist in picking up good sound.

For one thing, on-camera mics tend to hear zoom motors and other camera created noise.

Mounting the mic parallel to the ground is not a good practice, either. Shotgun mics are similar to telephoto lenses in that they both compress planes of action so that very little distance *appears* to separate foreground and background action. If you point a mic horizontally towards a person, you will pick up the sound of that person as well as the background sound directly behind that person.

Boom operator John Bauman demonstrates RoboPole, AT4073a shotgun, and AT8415 shockmount. Photos by Philip Silver C.A.S.

The best way to isolate the person from the background is to boom them from above, so that the line of sight of the mic runs towards the person's mouth and then towards the ground. (It is safe to assume that the ground or floor is not as noise producing as the background.)

Finally, the camera lens has the ability to SEE much further than even the best shotgun microphones can HEAR. A long lens can easily frame a tight close-up of a person's face from 50 feet away; but the only thing that a mic would pick up at that same distance would be general background ambiance of everything in the entire wide scene. **To achieve good sound, you have to get the mic as close as possible to the action!**

Boom it from above if you can.

Overhead miking from a fishpole or studio boom is the most favored technique in the feature/TV/commercial industry. It is probably the best choice 90% of the time.

Generally, overhead miking will yield the most natural sounding dialogue with the least amount of mixing and editing effort.

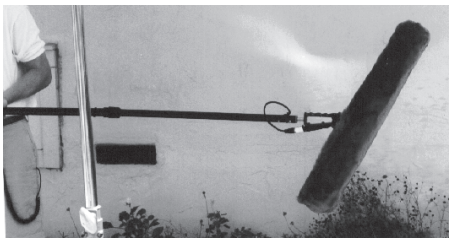
It provides a pleasant blend when there are multiple actors involved. Two, three, even a small group of people interacting can all be recorded from a single mic.

A mic on a fishpole or boom allows for a fair amount of physical activity and movement by the talent. Actors are free to enter and exit a scene, move around, jump around, climb around, etc. There are no trailing mic cables to inhibit their range of motion. Nor are there the frustrations of dealing with finicky wireless mic systems with their inherent problems of environmental RF interference.

An overhead mic will pick up sufficient sound effects, footsteps, and hand-prop noise to give the soundtrack a full texture. Because the faces are closer to the mic, dialogue will dominate the track, but other sound effects will still be audible.

Audio perspective is easier to maintain with an overhead mic. On a wide master shot, the mic tends to be higher so that the resulting dialogue seems thinner and more "distant". On close-ups, the mic can be lowered giving the sound much greater presence and "nearness" to the screen.

But what if there are physical obstructions in the set that prevent deploying a microphone from overhead?



That brings us to the next option: Boom miking from underneath. The boom mic can be aimed upwards at the talent from knee,

thigh, or waist level with good results. The sound will be slightly more bassy than miking from overhead, but still quite usable and acceptable. Note that a mic aimed up at a person tends to pick up more of the chest cavity, thus accounting for the increase in bass.

Sometimes it is much more difficult to boom from below, due to the presence of set furniture or the choreography of foreground persons. Camera operators also have to be much more careful, since it is more likely to widen the frame to show more of an actor's torso than to show more empty headroom above. Never-the-less, there will be many shots where miking from below is the simplest solution.

Tips on using your boompole

Amount of extension

How long a boompole you will need really depends on the type of production you will be doing. Feature films, commercials, and episodic television calls for a long reach, around 12 to 15 feet, in order to cover the set. News gathering and *"run & gun"* documentary style traditionally requires a shorter reach, around 5 to 8 feet, since the camera crew is more mobile and working close-in.

Whenever you extend a boompole, do not lock the pole sections extended all the way to the safety stops. **The proper technique for achieving maximum reach is to slide the pole section to the stop, and then back it in a couple of inches.** A slight overlap will make the pole sturdier (no wilting at the locking collars) and quieter.

Another good practice is to extend the pole further than what you need for the shot so that you can grip the boompole closer to its center of gravity (think of a circus tightrope walker's balance pole). By letting the pole counterbalance itself in your hands, your muscles will not be exerting to overcome torque.

Preventing cable noise

Cable noise in a boompole can originate from three problems: **conductance**, **percussion**, and **loose connections**.

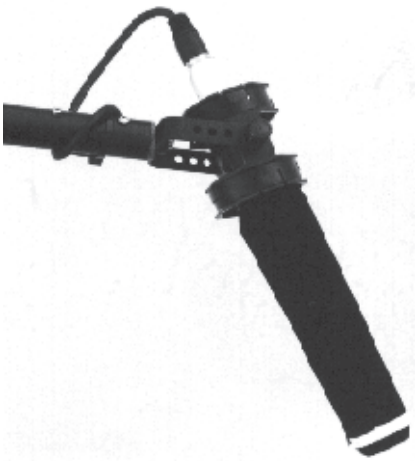
Conductance is noise or rumble (physical vibrations) that travel along the sheath of the cable. To prevent this, the inside tube section of the boompole should be foam dampened. For instance, in the RoboPole® the cable is fully enveloped in compressed foam rubber for the entire length of the inside section.

To maintain the pliability and cleanliness of the mic cable, routinely wipe it down with a restorative solution such as Armor All™.

Percussion is noise created by the cable banging against the remaining tube sections of the boompole. Since the pole telescopes, it is impossible to foam dampen any but the innermost tube.

The best technique for controlling cable percussion is to keep the cable taut while holding the boom. **As the cable exits from the pole, loop it around the little finger or thumb of your supporting hand and keep the line snug.** Do not allow the cable to merely exit the pole and drop to the floor!

The final cause of cable noise can be the mic connection.. XLR connectors on mics as well as cables have been known to loosen from continuous usage. **Place a strip of cloth camera tape over the junction where the microphone connects to the boom cable to protect against intermittent connection occurring when the mic is moved around.**

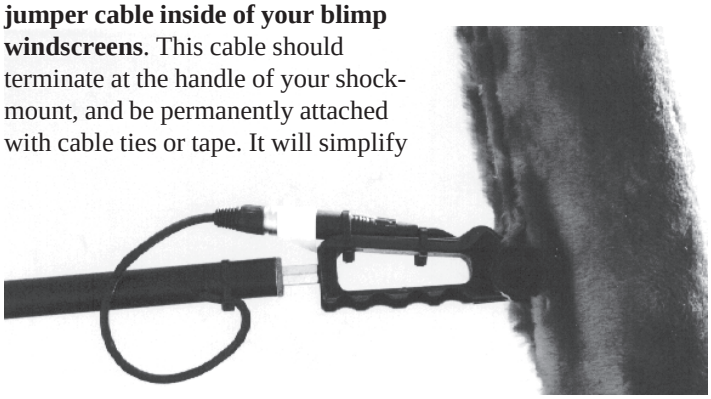


Always maintain some slack in the cable connection between boompole and microphone. A taut cable will conduct handling noise.

On the same token, **excess cable can flap** around and cause noise. This excess can simply be wrapped once or twice around the pole beneath the shock-mount.

The cable on the RoboPole® is **cable-tied in a small loop** where it exits the tip of the pole in order to reduce conductance as well as to serve as a strain relief.

Another useful trick is to **use a short jumper cable inside of your blimp windscreens**. This cable should terminate at the handle of your shock-mount, and be permanently attached with cable ties or tape. It will simplify



the process of mounting your shockmount to the pole, because it will no longer be necessary to open up the windscreen and dress the cable every time you need to use the mic.

Holding the boom

To reduce handling noise, **grip the pole firmly** but not tightly with your fingertips and avoid excess hand or finger movement such as tapping or drumming. Some boom operators wear white editing gloves to reduce finger sticking on excessively cold or hot days.

Hold the **boom parallel to the floor and high above** your head with both arms. If you support the boom underhanded like a flagpole, the boom will enter the scene at a steep angle. Although the mic may be high enough to clear the frame line, the body of the pole may cut across the corner of the frame.

Proper arm placement: vertical and close-in.

Keep your **arms close to your head**, sort of like a capital "**H**". When your arm is vertical with the elbow locked, all you are doing is supporting a couple pounds of weight in a straight line with your body.

Arms too wide.

If your arms are extended in a wide "V", your muscles will fatigue quickly.

Also, when your arms start from a true vertical, it is **possible to quickly reach in or out** with the boom to follow the action.

Use your **front arm as a fulcrum to support** the pole above your body. If the situation permits, grip it towards the natural balance point of the boom. Use the **rear arm to steer** (pan/tilt) the boom, as well as to rotate the pole in order to cue (aim) the microphone.

Microphone Placement

Try to **position the mic as close to the action** as possible. Depending on the situation and the characteristics of each particular microphone, your mic may be several inches to a few feet overhead of talent.

Be aggressive in your mic placement. Ten feet overhead may be very convenient for the camera and lighting crew, but your dialogue will be poor. Remind the director that a wide angle lens can always be tilted downward so that the frame is not filled with ceiling or sky at the cost of his soundtrack!

Professional boom operators often **place a strip of white tape on the tip of the windscreen** so that the camera operator can readily spot if the mic has dipped into the shot. Better to see the mic in the viewfinder than to wait until it shows up on the big screen.

To establish a working frame line, **dip the mic completely into the shot and slowly raise it up** until the camera operator tells you that you're just barely clear. If you start the boom up high and gradually lower it towards the frame, the camera operator will usually play it very conservative and tell you to stay higher than necessary.

Shockmounts & Windscreens

Two of the worst problems that plague location sound recording are RUMBLE and WIND NOISE.

Rumble can be defined as unwanted bass vibrations transmitted through objects into the mic capsule itself. Examples of rumble include ground or floor vibrations caused by nearby traffic, heavy footsteps, and building/structural vibrations. In addition to rumble, a closely related malady is that of HANDLING NOISE — created by the friction or light tapping of human fingers, either directly against the microphone itself or conducted through whatever means by the microphone is supported (e.g. fishpole).

Merely filtering out the low frequencies at a mixing panel will not correct the whole problem. Low frequencies can quickly overload the pre-amplifiers of some microphones and most recorders. To avoid the risk of permanent audio distortion on your tracks, these low frequencies should be controlled BEFORE THE SIGNAL IS PROCESSED BY THE MIC ELECTRONICS.

The solution to rumble lies in isolating the microphone from these vibrations by some means of free-floating suspension or non-conductive insulation... which is the role of a good shockmount.

Not to be confused with shockmounts are MICROPHONE CLAMPS. Although both are intended to fulfill support functions, the difference is that a clamp is merely designed to hold a microphone — not to isolate it from vibration. Clamps are manufactured from conductive, hard materials such as plastics and metal.

Because mic clamps (sometimes referred to as mic stand adapters/holders) are cheap to manufacture, they are supplied free with most microphones and you'll often find boxes full of them in the A/V supply rooms.

Although clamps may be acceptable for use with relatively insensitive (dynamic) mics such as those found in hotel conference rooms, they should not be used with the highly sensitive shotgun mics associated with professional film and video production.

Instead, make it a habit to always use an isolation shockmount.

A good shockmount does not have to mean big bucks. For example, the two most popular shockmounts in use by the professional film and video industry sell for under fifty dollars!

One of the old favorites (but getting rare these days) on Hollywood sound stages is the ElectroVoice model 307 "spider" mount. This simple design consists of a plastic cradle suspended at all four corners within a framework of rubber tubing. The rubber is held in position on a thin, rectangular frame that is screwed onto a U-shaped metal yoke.

The 307 was originally designed to hold the 3/4" diameter handmics of the ElectroVoice line, such as the RE635a, RE10/11, RE15/16 and others. However, sound mixers soon discovered that the 307 was ideal for use with the 19mm diameter short shotguns of the Sennheiser line, such as the MKH416.

Some sound mixers modify the 307 by substituting rubber surgical tubing in place of the more solid rubber supports officially supplied. The surgical tubing is quieter, but a slight drawback is that it does not support the cradle as firmly in the event of a fast move.

Without a doubt, the overall most popular shockmount in use by the video industry is the model AT8415 "rubber band mount" manufactured by Audio Technica. This inexpensive universal shockmount consists of two pair of thick rubber bands arranged tic-tac-toe fashion within a cylindrical framework. The mic is held inside of the "center square" of the grids formed by the rubber bands.

Since the AT8415 does not utilize a plastic cradle of fixed diameter, it will support just about any mic on the market except for the long shotguns.

Audio Technica AT8415 shockmount.

***WRONG** way to insert a mic. Simply placing the mic into the center grid formed by the rubber mounts will NOT hold the mic securely!*

***CORRECT** way to insert a mic. The lower rubber band mount is pulled OVER the top of the mic, and the top band pulled UNDER the bottom of the mic for a firm grip. If more tension is required for a heavier mic, then the two side bands can also be crisscrossed.*

Extra support for longer and heavier mics is achieved by criss-crossing the rubber bands so that the mic is firmly sandwiched. Heavy duty spare EPDM bands are available from Equipment Emporium.

The yoke of the AT8415 is drilled and threaded to accept a 3/8" mounting screw, such as those found on standard fishpoles. An adapter is supplied for use with common mic stands and goosenecks.

The AT8415 is definitely a “best buy” considering its low profile appearance, design simplicity, adaptability to a wide variety of mics, and excellent isolation performance.

To attach the 8415 mount onto a camcorder, use a ***3/8 to camera shoe*** adapter, such as the one from Equipment Emporium.

Another shockmount for attaching the mic to a boompole is the new K-SM from K-Tek.

An excellent shockmount for use with camcorders is the Light Wave MM-USC mini-mount. It features an offset arm that allows you to swing the mic from side to side.

Shockmounting a miniature microphone such as a lavalier is easier than one might imagine. It is very common to mount small mics onto table tops, walls, and all sorts of props. A short strip of cloth camera or gaffers tape, loosely wadded into a loop or a ball, will suffice. Lavalier mics have very little mass, so they are easily supported by a single thickness of tape. The cloth and adhesive gel of the tape are very efficient at dampening vibration.

An adjunct of shockmounting the microphone is to shockmount the potential source of noise and vibration. The Hollywood industry uses a material known as “foot foam” to cut down obvious trouble areas. Foot foam is adhesive backed, thin neo-prene rubber which can be cut and affixed to shoes, boots, glassware, table tops, bases of mic stands, etc.

Foot foam is cheap and expendable; your dialogue track is not.

Moving up the scale in terms of quality and price brings us to dedicated pistol-grip shockmounts.

Pistol-grip shockmounts are usually designed to accommodate just one or two specific microphones. The mic mounting clips are usually specific in diameter; 19mm and 21mm are the most common. The spacing from front clip to back clip is engineered for specific mic length and mass. The rubber mounts supporting the clips are also optimized for a particular load.

The pistol-grip handles themselves are drilled and tapped to accommodate the standard 3/8" thread found on fishpoles. Some of the shockmount manufacturers also offer short fishpole mounting yokes in lieu of the handles, but the majority of users prefer the handles.

The pistol grip shockmounts sell for around $170, give or take, depending on manufacturer, model, and your personal discount.

In general, this class of shockmounts are more fragile than the cheaper ones. However, the pistol-grip mounts are quieter and more efficient at their task, especially when it comes to the longer shotgun mics.

Pistol-grip shockmounts are manufactured by Light Wave Audio (U.S.), Rycote (U.K.) and Sennheiser (Germany).

Rycote uses a suspension style for shorter mics whereby the mic clip is hung from elastic string within a horseshoe shaped cradle. For the longer mics, the mounting clips sit on a pie-shaped wedge of neoprene rubber.

Sennheiser uses a variety of mounting systems, depending on their particular model.

Light Wave Systems manufacture what has become a very popular system on the market. The mic clips sit on an inverted “V” of rubber blocks. Spacing of the mounts is individually designed for each model microphone in use by the industry.

Light Wave also has introduced a couple of newer designed mounts for studio boom applications.

Over the years, Light Wave has been very responsive to the needs of the industry, and kept refining their product into what are generally acknowledged to be the quietest shockmounts on the market. And the fact that they are located in the United States (Los Angeles) sure makes it easier to get them on the phone!

One quick note about shockmounts and thread sizes. It has been mentioned that shockmounts come equipped with some sort of mounting hole or adapter for use with fishpoles and mic stands. There are three different thread sizes that you may encounter: 3/8", 5/16", and 5/8".

The current standard thread for fishpoles is 3/8". The slightly smaller 5/16" used to be the standard in Hollywood, but has pretty much been replaced by the more popular 3/8". Older fishpoles and pistol-grip handles may require a simple adapter for use with 3/8".

The larger 5/8" thread size is the standard for mic stands and goosenecks. Most mic clamps are threaded for 5/8", although some are also supplied with a 3/8" insert adapter.

Now, on to the subject of windscreens.

One of the most important differences between the inexpensive shockmounts and the pistol-grip shockmounts is that the pistol-grip mounts are designed to mate with blimp windscreens of the same manufacturer. For microphones intended strictly for indoor applications, blimp windscreens are of minor value. But for condenser shotgun mics that will work outside, the capability of attaching a blimp is a necessity.

Before we get into a discussion of windscreens, a preliminary word about WIND NOISE.

There are two types of wind noise that will affect your soundtrack: ACOUSTIC WIND NOISE and CONTACT WIND NOISE.

Acoustic wind noise is the howling that the wind makes blowing through trees and between buildings. It is a form of ambiance, just like traffic noise. Because it is background noise in our environment, it cannot be controlled by a windscreen.

Rolling off or filtering out the low frequencies will help somewhat, but howling wind is made up of a lot of higher frequencies as well, so eliminating the bass is only a partial help.

The best way to eliminate acoustic wind noise is to close mic the talent. Get the microphone in as close as you can get it, and then lower your mic gain (volume) so that dialogue dominates the soundtrack instead of background ambiance. That’s really about all that you can do.

Contact wind noise, on the other hand, is that blast of distortion and audio breakup caused from wind physically striking the sensitive diaphragm of the microphone capsule. We’ve all heard that sound when someone blows directly into a microphone.

The distortion created by contact wind noise cannot be fixed in post-production. It can only be chopped out along with the accompanying dialogue; and a new piece of dialogue cut in to replace it.

But contact wind noise can be prevented. That's what a windscreen does.

The simplest windscreens are known as "pop filters". Pop filters may be of either thin foam or metal mesh. Their purpose is not to defend against natural wind, but to block the exhalation from a performer, known in the industry as "breath pops".

Pop filters don't do much against real wind, but anything is better than nothing.

Thicker foam windscreens will protect against light breezes, both indoors and out. At no time should a shotgun mic ever be used without at least a foam windscreen. Even indoors, the mic can encounter moving air (wind) that would cause breakup. Air from heating/cooling systems, open passageways, and even from moving on the fishpole are all indoor wind hazards for the highly sensitive mics that our industry uses.

Another good reason to always use a foam windscreen is to physically protect the microphone from dust and accidental impact.

Outdoors, a foam windscreen will provide only minimal defense against wind noise. Foam will suffice for the less sensitive electret condenser (ENG-type) shotguns such as the ME66 and AT835, but the highly sensitive true condenser shotgun mics such as the MKH60/70 and AT4073/4071 definitely require a blimp system.

Light Wave Systems and Rycote both make products that are an affordable compromise between the full, pistol-grip shockmount/zeppelin windscreens and just plain foam. The Light Wave Equalizer is a smaller, mesh windscreen with integral furry outer covering that slips over a mic in lieu of the foam windscreen. Use a standard minimount or universal shockmount to hold the mic. Rycote makes the Softie, which is similar.

In a pinch, you can improve upon a foam windscreen by wrapping it with several layers of cheesecloth, and then containing the whole affair within a sweat sock. If you are faced with a real windstorm, anything goes... terry cloth towels, chopped off sleeves from a sweatshirt, etc. Just so long as the covering is porous.

Windscreens work by providing a barrier against moving wind. We can define windscreens as single stage barriers, two-stage, and multi-stage.

The simple foam windscreen is an example of the single stage barrier. Moving air is slowed down by the porous foam before it can strike the mic element.

The basic blimp windscreen is an example of two-stage protection. The outer mesh shell slows down the approaching air. Whatever air passes through the mesh is then further slowed down by the non-moving trapped air within the blimp screen itself.

The effectiveness of a blimp windscreen can be improved by adding additional barriers between the onrushing air and the mic element; this is known as multi-stage wind protection.

For instance, using a thin foam windscreen over the microphone INSIDE of the blimp provides a major increase of wind protection. Make sure to leave plenty of airspace between the foam and the inside of the blimp, or else you will defeat the purpose of multi-stage wind reduction. That layer of non-moving air is vital.

The other way of improving a blimp windscreen is to use a fabric or synthetic fur "windsock" over the outer shell. The use of a plush "fur" is very effective because the "hair" tends to disperse the oncoming wind, thus reducing velocity but also eliminating the ACOUSTIC noise generated by high wind physically striking the outer shell of the blimp.

If the budget is tight, fake fur windsocks can be fairly easily sewn together by anyone handy with a sewing machine, such as a Costumer or Wardrobe person.

Emptying a full can of ScotchGuard onto your windsock will provide protection against rain. Heavy rain or firehoses may call for a protective condom over the microphone itself.

Hollywood sound mixers often manufacture “rain hats” made from rubberized “hogs hair” to slip over the blimps. The hogs hair is a rubberized, thistle type material that disperses the rain drops upon impact, thus eliminating the “pitter patter” noise that the water would otherwise make when it struck the windscreen.

An important guideline to follow when using windscreens is to only use as much barrier protection as is needed, but never less than what is needed. The more stuff you surround your mic with, the more you will interfere with the frequency response and even pattern of your mic. On the other hand, not having enough wind protection will lead to contact wind noise, which is not fixable in the mix.

One saving grace is to realize that when the wind is blowing up a storm, your actors will also be shouting their dialogue, so that some loss of frequency response is unlikely to affect the (lack of) subtlety of this forced dialogue anyway. Just don’t use windsocks and blimps on your indoor stuff!

Summary of all of this...

1) Always use a good shockmount and at least a foam windscreen.

2) The Audio Technica AT8415 universal shockmount is fine for indoors and works with most mics except long shotguns.

3) A good pistol-grip shockmount is needed for long shotguns, as well as for any mics that you will be using outdoors with a blimp windscreen.

4) Use a blimp windscreen for exteriors. A thin foam windscreen over the mic will help quite a bit. A fur-type windsock provides even greater wind protection.

Microphone Powering

The topic for this article is “red dotting” microphones and other basics pertaining to “phantom” powering of mics. If you are already intimately familiar with such terms as: T-powering; A-B powering; phantom powering; electret condenser; QPM 3-5; QPAU-T; and phasing cables — then give yourself an A and skip on to another article in this booklet. But if any of this talk strikes you as resembling a call sheet from a sci-fi epic, then this primer is for you. For the purpose of simplification, microphones will be divided into three basic categories: dynamic, condenser and electret condenser.

Dynamic microphones operate directly off of existing sound pressure. The sound waves themselves move an element in and out of a magnet, thus generating electric pulses (audio signals). Dynamic microphones require a fair amount of kinetic energy, which in turn makes them not as sensitive to subtle noises or faint sounds.

On the other hand, because they are so mechanically simple and durable — dynamics are ideal to use in loud-noise situations, such as the recording of explosions. Used close to the mouth in a loud background situation, they will deliver a surprisingly clean voice track.

Dynamic microphones do not require any sort of external powering. Just connect them directly to a microphone level input and they are ready for use.

The next division of microphones is electret condenser. Without getting too technical, this class of microphone employs a lightly charged electromagnetic element. Whereas the dynamic microphone operates sort of like a generator, creating electrical impulses by passing a coil through a magnet -- the electret condenser is more of a capacitor. That is, it varies the flow of an existing electric current based on actions caused by sound pressure. Imagine dynamic microphones as manual typewriters, and electret condensers as electric typewriters. The electret condenser class are considerably sensitive to sound and can be made somewhat directional. For the most part, electrets work off of approximately 1.5 volts of DC current and draw very little power.

Powering for these mics is usually supplied via a built-in battery supply, found either in the “handle” of the mic or in the connector.

Virtually all of your professional lavaliers are of the electret condenser variety, such as: the Audio Technica AT803, MT830, Sony ECM44, ECM55; Tram TR50; Countryman EMW, B3; and the Sennheiser MKE2. Most of these mics operate off of a single AA style battery. The TR50 uses an S76 “button” battery (often located in an in-line plastic housing near the connector).

Most of the medium priced ENG shotgun microphone systems are also of the electret type. The Audio Technica AT835b and AT815b shotguns as well as theSennheiser K6/ME66 -- all take an internal AA battery. The older K3U series (ME2O omni, ME4O cardioid, ME8O hypercardioid) utilizes a rare 5.6v camera battery.

Very rarely does a battery go dead due to normal use. Most microphone manufacturers claim an estimated continuous working life of 1,500 to 3,000 hours per single battery. That’s at least two solid months or longer, even if you never take the battery out at the end of the day.

The most common cause of electret microphone failure is that the battery was installed backwards, or that no battery was installed at all. Sometimes, one of the battery contacts might only need some polishing (a crisp dollar bill works very well for that purpose).

Since electret condensers have their own battery supplies, they can be treated the same as dynamics as far as connecting them to a microphone level input is concerned. Just plug them in.

The third category of microphones, and the group that accounts for the most confusion regarding powering, is that of the true condenser.

True condenser microphones are the mainstay of the professional industry. They go beyond the electromagnetic capacitor design of the electrets, instead employing sophisticated discriminator-tuned circuits. Suffice to say that these condensers are capable of greater sensitivity and sound quality than their counterpart electrets, but condensers are physically more fragile.

Good examples of condenser microphones are the Audio Technica AT4073a & AT4071a, and the Sennheiser MKH416/816 & MKH 60/70 "shotgun" mics.

Condenser microphones require a stronger voltage in order to operate. This is usually either 12 or 48 volts, depending on model. Most current mics use 48 volts, whereas older mics intended for film and television may use 12 volts.

There are three different designs of remote microphone powering. These are: 48v phantom; 12v phantom; and 12v T powering (also referred to as 12v A-B powering).

The difference between phantom and T-powering is the route by which the powering voltage is transmitted to the microphone through the cable.

In T-powering (A-B powering), the 12 volts are sent to the condenser microphone through the standard three-pin XLR mic cable, employing pin 2 as positive and pin 3 as negative. Note that pin 1 acts as shield, and does not carry operating voltage.

In phantom powering, which exists in both a 12v as well as a 48v version, pin 1 is negative while pin 2 and 3 are both positive.

Condenser microphones do not contain their own power supply — some sort of external powering must be employed. This may consist of either a T or phantom power supply (running off of battery or AC), or a provision in the recorder or mixing console to supply the condenser powering.

For field work, the microphone powering can emanate from a battery supply, from some mixing panels, or sometimes directly from the recorder (or camcorder). Battery supplies measure close to the size of a cigarette pack, and typically operate from one or two 9v batteries and may contain built-in pads or low-cut filters. These units are employed between the condenser microphone and the mic level input. The output from these units is handled the same as for dynamic microphones.

In lieu of using a battery power supply, some production mixing panels have the capability of providing T or phantom powering directly. Make certain that the panel is designating the type of powering that the mic requires. Phantom is not the same as T-powering (A-B powering). Most of the inexpensive mixing panels built for music recording only feature 48v Phantom powering, but there are adapters on the market that can convert Phantom to T power if you need it.

Only a few models of prosumer camcorders offer built-in 48v Phantom mic powering, so you may need a battery power supply to go between the camera and the mic. (You may also need a suitable XLR to stereo mini adapter.)

Condenser microphones may also be powered directly out of a Nagra — providing that the proper pre-amps are installed in the recorder. Nagras employ two microphone pre-amp modules, which commonly are of the following varieties: QPSE-200-XOYO QPM3-5, or QPAU-T/QPU-T.

The "regular" pre-amps (QPSE.200-XOYO) are made for standard low-impedance dynamic microphones. These pre-amps will also work with (self-powered) electret condenser mics, and with condenser microphones in conjunction with an external battery power supply.

The QPM 3-5 pre-amp is designed for T-powered condensers, such as the older 416 and 816 Sennheisers. It will provide the necessary DC voltage.

Early Nagras could come with two regular pre-amps, two 3-5s, or one of each. Specify what you want when ordering or renting. Remember though, a condenser mic with a power supply will work with the regular pre-amp, but a dynamic or electret mic will not work with a 3-5 (you'll get no audio) — so don't lock yourself in with 3-5 unless you are certain that only condensers are going to be used on the shoot.

Newer Nagras may be equipped with the Universal pre-amps (QPAU-T/QPU-T). These pre-amps are switchable and can he used with dynamic, T-powered and phantom mics. The QPAU-T is the mother pre-amp and is found in the Mic One position only. To change between mic settings, there is a slotted adjustment switch near the left side corner. The QPU-T pre-amp is for Mic Two only, and is adjustable from the inside of the machine. Ask a technician to show you how it works.

If you are using a Nagra with Universal pre-amps, and the mic doesn't work, make sure the pre-amp selector switch is in the correct position. A hint: dynamic is at one extreme of the switch and T-powering is at the opposite extreme.

Another interesting means of powering a mic from a Nagra is to employ a KAT-15 cable amplifier (made by Sennheiser). This small device plugs into the accessory socket of the Nagra and takes its power directly from the machine. The power drain on the Nagra is negligible. The KAT, besides providing T-powering, also expands the capability of the Nagra because it converts the line input pot into an additional microphone input. Two mics can now be mixed into a Nagra III, or three mics into a Nagra 4.2, without an external mixer. The KAT is switchable for use with either T-powered condensers or regular dynamic mics.

Now here is the great source of confusion. Nagra pre-amps are wired the reverse of the standard audio industry, when it comes to pin 2 and pin 3 of the microphone input. The reasons are complex and vague, but that's the way it is. What this means is that the T-powering coming from either the QPM 3-5 or the Universal pre-amp shows pin 2 (usually positive) as negative; and pin 3 (usually negative) as positive.

However, since Nagra was the standard of the motion picture industry, it has become common practice to simply reverse the leads for pins 2 and 3 inside of the condenser microphones to make them Nagra compatible. To indicate that this modification has been performed, the outside casing of the microphone is traditionally marked with a red dot — hence the expression "red dotting."

The problem is that the end user must be cognizant of not only whether or not his or her microphone is standard or red-dot, but also of the polarity of any battery power supplies as well as the polarity of any remote powering capabilities of the mixing panel. Make sure everything is compatible.

A life-saving accessory is the phase-reversing cable. This is merely an adapter or foot-long XLR cable, in which the leads to pin 2 and pin 3 have been reversed at one end. One of these, inserted between the condenser microphone and the power source, will correct any "red-dot to standard" mismatch that may have occurred either due to oversight or the last minute addition or replacement of equipment.

Finally, it is important to remain aware that by switching around pins 2 and 3, the acoustic phasing of the microphone has been reversed. There is a difference in meaning between acoustic phasing (the audio signal) and polarity (voltage supplied to make the mic work). If you are employing more than one microphone at the same time, you might have to reverse the acoustic phasing of some of the mics (even dynamics and electrets) in order to prevent the mica from partially canceling each other out. This would entail either throwing a switch in the mixing panel, or inserting a phasing cable between the mic and the input. In the case of condenser mics, a phasing cable might be inserted between the power supply and the input. Let your ear be the judge.

Selection and Use of Lavalier Microphones

A brief history:

Originally, the term “lavalier” referred only to the “neck-worn” or “body-worn” class of small microphones. These days, the working definition of lavalier has been extended to include virtually any miniature microphone small enough to be worn on the body and/or hidden in the set.

The first lavaliers used by our industry were large, dynamic microphones about the size of a cigar tube. These mics were traditionally worn around the neck by means of a lanyard (lavaliere). The mics were very rugged, but had a very short pick-up range and had to worn close to the mouth. Because of their relative insensitivity to sound, they were very feedback resistant. Units manufactured by Sennheiser and ElectroVoice were very popular in their time; many can still be found at garage sales, priced to go at almost free.

By the way, it is worth noting that the author still keeps a vintage ElectroVoice 649B dynamic lavalier in his sound kit for use as a slate mic or as an “expendable” sound effects mic.

The technology of the sixties saw a miniaturization of the lavalier. The Sony ECM-50 became the broadcast standard. The ECM-50 was an electret condenser, omni lavalier. Compared to the older dynamic lavs, the ECM-50 was considered miniature, even though it was almost one inch long by half an inch in diameter. The ECM-50 was far more sensitive, and its greater bass response complimented the golden throated newscasters of the era.

Years later, Sony introduced the ECM-30, a smaller and less expensive version of the ECM-50. Film and video people took a liking to it immediately. The ECM-30 was much smaller and easier to hide. More importantly, the mic lacked the extended bass response of the ECM-50, which translated into less wind noise and rumble when used outside of a studio.

Of course, over the years, other manufacturers entered the marketplace with lavaliers of their own. Witness the ElectroVoice CO-90, the TRAM TR-50, the MiniMic, the Sennheiser MKE-2, and others.

Which brings us up to the present.

Proximity vs. Transparent Lavaliers: (terms coined by the author)

Modern lavaliers can be described as being either “Proximity” or “Transparent”.

A Proximity type lavalier is defined as a microphone that works best when kept fairly close to the source of the voice, emphasizes that voice, and suppresses background.

A prime example of this sort of lavalier is the ECM-55 (the current successor to the ECM-50).

Proximity lavaliers produce the “lavalier perspective”; emphasis of the voice in a “tight close-up” sort of way. You know -- the newscaster, stand-up reporter, on-camera narrator, radio interview, voice of authority kind of sound.

Proximity lavaliers are the best way to go if you desire an authoritative sound with minimal background noise. They are also the mic of choice if there is simultaneous sound reinforcement (public address), since they are not as prone to cause feedback as other more sensitive mics.

Transparent lavaliers are defined as sounding more like omnidirectional recording studio mics. They are very sensitive to sounds, and their volume vs. distance characteristics are far more gradual than that of proximity lavaliers. Transparent mics can be deployed at greater distances; and are far more forgiving of talent turning their heads away from the mic.

Transparent mics sound much more natural and less forced than proximity mics. Used on a video set, these mics will intercut much easier with overhead boom mics.

The drawback to transparent mics is that they are much more sensitive to background noise, and also require greater skill to hide under clothing.

The microphone lineup:

As mentioned before, the Sony ECM-55 is a longtime standard of the industry and is a proximity type lavalier. It is cylindrical in shape, measuring roughly 1/2" in diameter by 1" long. This mic has a pronounced bass response, and is excellent for audio interviews, narration, and public address. It is not as useful a mic to use outside of the studio, due to its sensitivity to wind and rumble. This mic is not very forgiving of off-axis voice; when talent turns their head away the sound level drops off considerably.

On the border between proximity and transparent is the Sony ECM-44. The ECM-44 is probably the most popular all-purpose lavalier on the market. It is more open sounding than the ECM-50, but still does a good job of suppressing background. It is somewhat forgiving of head turns. The mic exhibits a slight warmth in the middle frequency range, which promotes the clarity of voice over background. Also, the ECM-44 does not have the bass sensitivity of the ECM-55, making this a better sounding microphone to use in the field. Very similar in soundquality, but less expensive, is the Audio Technica AT803b.

Moving towards the transparent group of lavaliers, we come to the TRAM TR-50. This very tiny microphone differs from the Sony's in that it has a front facing grill. The Sony's have their openings on the top.

Remember, all of these lavaliers are omnidirectional, so it does not matter which way the mics or their grills are oriented. Just pay attention when you are rigging them so that you don't accidentally block up or tape over the hole.

TRAMS are famous for their wide array of mounting clips and tricks. In addition to the traditional tie bars, TRAMS also offer vampire clips, PZM type plastic mounts, leather tapedowns, and a host of goodies.

The sound of TRAM is very good. It is more transparent and natural sounding than the ECM-44, but not quite as open as some of the other transparent mics.

Countryman and Voice Technologies make some interesting lavaliers. The Countryman mics are offered in a flat faced configuration (EMW) as well as a miniature round top (B3). Countryman also makes a super miniature round top not much thicker than a spaghetti noodle (B6). Voice Technologies offers a flat faced configuration. What makes both of these brands interesting is that they are proximity mics (short range, strong rejection of background) but with a very natural sound. Originally created for Broadway shows, these mics are useful to filmmakers who need to mike actors within a noisy environment. But they are not good as plant mics.

My favorite transparent lavaliers to use are the Audio Technica AT899 & MT830, Sennheiser MKE-2, and the Sony ECM-77. All of these lavaliers are extremely sensitive, and work very well as plant mics or

AT899

body mics. They sound very natural, and intercut perfectly with overhead boom mics. They make excellent plant mics hidden in sets. They also allow the pickup of other persons near the actor wearing them; very handy in a documentary or covert situation.

Their drawback, however, is their sensitivity: sometimes they can hear too much background. They also require more care in rigging under clothing. But they do sound great!

Rigging lavaliers:

Outside the Clothing

In many situations, it is permissible for the microphone to be visible in the shot. Needless to say, this simplifies the process of rigging the little devils quite a bit!

To begin with, you should be familiar with the proper technique of using a tie bar type mounting clip.

Secure the mic capsule (head) in the clip as one would expect. Then, loop the mic cable around in a "J" so that it circles upward and re-enters the tie clip. The cable should pass freely through the closed end side of the clip where it hinges (the side farthest away from the jaws). With the tie bar in place on the clothing, continue the mic cable up and around so that it completes a circle behind the clothing. Bring the cable back down (still behind the clothing) and secure it inside of the spring jaws of the clip. The action of the metal clip will serve to eliminate conductive cable noise from being transmitted to the mic capsule. It will also strain relief the mic from any tugging or pulling on the cable.

The remainder of the lavalier's mic cable should be hidden behind talent's clothing. Although it is acceptable for the microphone itself to be visible to the audience, there is never an excuse to see a sloppy cable!

The thin cable of the lavalier terminates at some sort of XLR connector/power supply. This supply should be hidden either in a pants pocket, waistband, or at the ankle. Never encourage talent to drag this XLR connector around; you risk great damage to the frail cable and electronic connections. Instead, always secure the connector end to talent, and simply plug a standard XLR mic cable into it. At the end of a take, simply unplug the heavy mic cable from talent and they are free to roam the set without risk to your lavalier mic.

I have found that a heavy duty rubber band with a safety pin works well to secure the power supply inside of a waistband if there are no convenient pockets to use. A heavy sock (or at least the ankle portion of one) works well at the ankle; as also does an ACE bandage or a salvaged ankle holster. Even a strip of gaffers tape works well, but remember to line the ankle with cloth or

The Newsman's Loop
Proper use of the tie clip

1. Insert the mic head into clip.

2. Bring cable up and thru the hinge, and then continue down thru the jaws of the clip. The jaws serve to mute cable vibration.

3. Frontal view. The mic cable curves around and up thru the hinge. Then it continues behind clothing downward thru the jaws of the tie bar.

4. Seen from behind the clothing. The loop continues up from the mic and then loops down thru the jaws.

toilet tissue first. Velcro straps are fine on males, but will destroy fine hosiery and stockings.

Clip-on lavaliers are often attached to the center chest opening of a shirt/blouse or to the necktie. They can also be attached to the lapel of a sports jacket.

If attaching to a lapel, make sure that you attach to the side most likely for talent to turn towards. (Towards the interviewer, towards the projection screen, etc.)

Although the lavalier is visible to the camera, it does not have to be conspicuous. Remember that in a wide shot, the lavalier is very tiny on screen. In a close-up, the lavalier will be framed out of the shot.

Just a little judicious camouflage will make the lavalier all but invisible. Cover the visible portions of the mic and clip with small strips of white camera tape. Color the tape with magic markers to match the color and pattern of wardrobe.

Hiding Lavaliers under Clothing:

Hiding a microphone under clothing requires much more attention to detail. Not only must the mic be hidden from view, but you must also contend with the problems of clothing noise.

Clothing noise comes in two varieties: Contact and Acoustic.

Contact clothing noise is caused by clothing physically rubbing against or striking the mic capsule or mic cable. The best means to eliminate this type of noise is to immobilize the clothing around the mic. If the garments cannot move in relation to the mic, then they cannot rub or strike the mic!

Different sound mixers have different techniques for accomplishing this feat, but my preference is the use of sticky triangles (often augmented with pins).

But first, we have to eliminate cable noise. Do this by forming one or two complete loops of the cable just below the mic capsule. The loops should be around one inch in diameter. Tie the loops in place with a piece of thread or dental floss, or even a thin strip of camera tape sticky side out.

The loop should be secured loose enough to open and close freely when the cable is tugged. This becomes your strain relief.

Secure the mic capsule within two small triangles of sticky tape. I make these triangles from a 1" wide by 2" long piece of camera or gaffers tape, folded corner to corner several times like a flag, sticky side always out. The mic is centered within the two triangles. Be careful not to tape over the grill or holes of the mic. Round top mics are easier to rig, since they can be surrounded by the tape, with only the top grill exposed. Flat facing mics require more care, since the stocky triangles need to be offset so as not to block the side port.

This sticky triangle rig can be placed just above a button of a shirt/blouse. The cable loop falls opposite of the button itself. The next inch or so of the lav cable should be taped directly onto the shirt, with the tape lengthwise between buttons. Any tugging of the shirt or cable with be strain relieved by this strip of cable. The floating loop isolates the tugging from the mic capsule. The sticky triangles anchor the clothing on either side of the mic. A couple of straight (or safety) pins may be used to secure the triangle tips if humidity or long duration are concerns.

Another technique is to use Moleskin strips and a safety pin to anchor the weight of the mic and cable. This is very useful if the actor will be rigged for an extensive period of time, or if moisture (perspiration, humidity, rain, etc.) tends to loosen the hold of sticky tape. Cut some adhesive backed Moleskin (found in the Foot Care dept of any supermarket or drugstore) into french fry size strips. Wrap a strip (adhesive toward the mic, softside out) completely around the body of the lav, insert an open safety pin, and continue the wrap.

The pin will securely hold the mic, but you may need to add sticky triangles to prevent clothing noise.

When wiring a female equipped with a bra, the sticky triangle can be re-angled so that it is flatside up, pointy end down, and can be placed inside of the bra, in the cleavage at the “cross your heart” point. The swell of the bosom acts as a shield against clothing noise, and results in excellent sounding mic placement.

The other type of clothing noise is that of Acoustic noise. Acoustic noise is created not from clothing rubbing against or striking the mic, but instead from the clothing rubbing against itself.

Static Guard works very well to lubricate clothing, such as jackets rubbing over shirts. Heavy starch

conducts noise, so it is best dealt with by applying or spraying a little water mist around the mic placement area, as well as in any other areas that would not appear obvious to camera.

As a rule of thumb, cottons and woolens are the quietest clothing fibers. Synthetics and silks are very noisy and should be avoided as much as the situation allows.

Lavaliers can also be hidden in other areas than just center chest. Under the collar works well with sweaters and sweatshirts, or women's blouses. Going under the collar of a dress shirt on a male may create a problem if beard stubble is present on the neck.

Less conventional mic sites include under the brim of hats, or hidden in the hair at the forehead. Small lavaliers can also be hidden on the frames of eyeglasses.

A very useful trick is to hollow out a plastic pen, and hide a lavalier inside. With but a very small incision in the back of a pocket, a pen mic can be planted in full visibility to the camera, with no clothing noise, and still remain completely "hidden".

Wind noise:

There are two types of wind noise: Contact and Acoustic. (Sound familiar?)

Contact wind noise is the one we most frequently associate with microphones. That is the distortion caused when wind strikes the diaphragm of the mic itself.

The solution is to use a good windscreen. Which you will have to make yourself, because the flimsy little puffs of acoustic foam that come with most lavaliers are merely breath pop filters, not real windscreens!

The simplest tool for blocking wind is to salvage the foam booty that makes up the working end of a video head cleaning swab. After you service your video heads, save these sticks! Believe me, the micro dust collected from a video head will not affect sound quality on a windscreen.

Pull the foam tips off of the wooden sticks, and then slice them open at the base to form a foam cap. Slide the foam over your favorite lavalier, and instant windscreen. Since these screens are disposable, feel free to color them with markers for less visibility.

If rigging under clothing, feel free to sandwich them inside of your sticky triangles. So what if the tape destroys them!

A greater level of wind protection can be achieved by placing an oversize metal grill (such as from an ECM-55) over the foam.

Another trick is to wrap a layer of cheesecloth over the foam and the mic. For visible mics, snip the fingertips off of a pair of wool knit children's winter gloves, and pull the wool "caps" over the cheesecloth. With a layer of wool, cheesecloth, and foam — you're very well insulated from wind noise.

When hiding lavaliers inside heavy winter coats, a good technique is to bring the mic to the outside of the coat (to avoid excessive muffling) and to hide the mic under a patch of cloth or felt. These patches are readily obtained as "sample" swatches from any fabric store. Cut the swatches into a random pattern, so as not to be conspicuous. Rub some dirt over the patch to help blend it in.

The other type of wind noise is Acoustic. That is the sound of the wind howling through the trees or between the buildings. It is a form of background noise, like traffic noise, and cannot be eliminated by the use of a windscreen. Your best solution is to keep the mics close to talent. Rolling off the bass frequencies also helps a little, but wind howling is often all over the frequency spectrum.

Lavaliers as Plant Mics:

The best solution to clothing noise is to keep the lavalier off of the body entirely.

Lavaliers are too stupid to know whether or not they are attached on the body, or just near one.

It is a simple matter to hide lavaliers onto many handheld props, such as purses, clip boards, flash lights, cups, etc.

To rig a car, hide a lavalier on the inside of the sun visor. Any decent transparent lavalier will pickup driver, passenger, and probably backseat passenger. The visor is padded to reduce echo, and well away from the bottom of the car with related engine & road noise.

Transparent lavaliers also work well as hidden mics in the set. A mic in the centerpiece can give you a restaurant table. A mic in an executive pen set can pickup both sides of an across the desk encounter. A mic on the inside of a doorjamb can give you that short line from a passerby poking his head into the office.

Use your imagination! A telephone booth is a snap to rig. Someone reading directly off of a blackboard or bulletin board is perfect for a hidden lavalier. The headboard of a bed for those “marital relations” shots.

Perspective:

A danger of using lavaliers is to forget to take perspective into account. A proximity lavalier always sounds like a tight close-up, even when the camera is fifty feet away.

Transparent mics sound much more natural, but unlike boom mics, their perspective is fixed. Booms move from farther to closer as the frame changes; lavaliers do not.

One quick fix to the perspective problem is to also deploy a shotgun mic directed at nothing in particular. The “bleed mic” is used to capture footsteps, ambiance, and general sound effects from an angle that will not pick up dialogue (two mics capturing the same sound will create phasing problems, echo, and tinniness). For long perspective, the bleed mic is mixed (say, 30%) with the dialogue from the lavalier. As the shot narrows to a close-up, the bleed mic is faded down, so that we are only left with the close-up sound of the lav.

Another trick to open up perspective when using lavaliers is to place them a little further down on the chest than normal. This creates a noisier track with more ambiance and less forced emphasis of voice.

Two actors playing opposite each other can be miked from each other’s lavalier, again opening up the soundtrack to appear more natural.

AT899 mics shown with mounting accessories.

TRAM TR50 shown with mounting accessories.

Using Wireless Mics

There is a saying in Hollywood that the use of wireless microphones is more of a mystic art than it is a science. In spite of all of the technological advances, achieving reliable performance from radio mics is still a *best case* rather than an *every case* scenario.

The fault lies not with the manufacturers, but with the government. Due to restrictions on power output and frequency allocation (sharing the wavelength with television channels), professional wireless mic units are readily susceptible to drop-outs and local RF interference.

What this means in plain English is that a twelve year old kid can walk into a Radio Shack and buy a walkie-talkie or CB that puts out 5 watts (5000 milliwatts), yet Uncle Sam won't trust professional soundpeople with more than 50 milliwatts!

As for the matter of RF interference, anything that has ever caused your television set to hiccup (such as overhead aircraft, vacuum cleaners, computers, passing trucks) may also interfere with your wireless mic.

Never-the-less, radio mics are definitely an important tool for Production Sound recording. They are often the only practical way to get the dialogue.

Think of them as wireless cables.

There is nothing *wireless* about the microphone itself. The fact is, it is the *cable* connecting the microphone to the mixer or recorder that is wireless. The microphone remains wired to the transmitter.

You may think that I am indulging in a silly game of semantics, but this is an important concept to understand. The lavalier mic is not the wireless part of the system; the XLR mic cable is what the transmitter/receiver is replacing.

Virtually ANY mic, including fishpole mounted shotguns, can be used with a wireless system providing that you have the appropriate adapter cable or connector.

Another concept that is important is that because wireless mics (of any brand) are always a bit of a gamble, you should hedge your bet by only deploying wireless when you absolutely have no alternate solution. Avoid reaching for your wireless as a first resort. *Using radio mics is sort of like going to the dentist: it is not a fun experience but we all do it when we have to.*

Exhaust all of the "hardwire" ways of miking a shot. If you can't boom it from overhead, maybe you can mic it from below. Perhaps a strategically placed "plant" or fixed mic can be rigged outside the frame or hidden within the set.

If you do need to resort to a body worn lavalier, it might be possible to trail a mic line from talent's ankle. Some scenes can be started on a wireless for the master shot, and then switched to boom mics or hardwired lavaliers for the closer angles.

Do wireless mics save the production company money?

There is a popular myth that using wireless mics will save time and money. Not!

Wireless mics cost money to rent as well as to operate.

For instance, the average daily rental for a good wireless system is approximately $35 to $60 per unit.

How many units do you need to budget for? The answer is: *a couple more than you plan on using.* If you have only one actor and you bring only one radio mic, then what happens if that radio mic stops working

either due to an internal electronic malfunction or on account of local RF interference on its frequency? Do we all get to go home for the afternoon?

Add to this the cost of batteries.

Radio mics can consume an awfully expensive pile of batteries over the course of a production. Most brands operate from 9-volt alkalines, which cost around $2.25 each.

The most common cause of poor radio mic performance is weak batteries! Always begin your shoot with fresh, premium batteries installed in the transmitter and receiver.

The battery in the body pack transmitter should be changed around every four hours, more or less. Even though some manufacturers claim eight hours of life, I don't know of any top notch soundpeople who feel comfortable going that long on one battery. After four hours, battery voltage tends to drop off steeply, along with transmitter range and clarity. In addition, you do not want to interrupt the flow of activity on the set in order to change batteries while the director is "cooking". Professionally, it is safer to change batteries frequently than to risk an ill-timed delay or a bad take.

Receivers don't eat batteries quite as much. Some receivers can last eight hours on a single battery, or a couple of days on two or three. And if you do need to check the voltage of a battery, or to replace it, it is usually easier to access the receiver (sitting out in the open) than to fumble with a transmitter buried under someone's wardrobe.

Battery voltage should be checked with a digital volt meter. Inexpensive digital meters can be purchased at Radio Shack and other places for under twenty dollars. A fresh 9-volt battery puts out around 9.30 volts. Replace your batteries at around 8.5 volts or slightly lower, based on your experience with the radio mics.

By the way, your "discarded" batteries still have plenty of voltage for most consumer devices, so it is not necessary to toss them in the trash. Just don't use them for professional equipment.

There is one more budget factor to consider... **time**. Radio mics require fifteen or twenty minutes per unit to properly hide and rig under wardrobe. Longer, if you experience difficulties with clothing noise.

Deciding to use radio mics on a shoot in order to save money is a mistake. It is less expensive and much more reliable to hire a good boom operator. But bear in mind that there are many situations where wireless is the best, if not only, practical option!

Choosing a wireless mic system.

There are several factors to consider when selecting a wireless mic system.

Handheld vs. Body pack:

Most of the wireless transmitters used for Production Sound are of the body pack format. Body packs with lavalier mics are commonly used for dialogue.

Handheld mics are generally used for vocal performance, or audience Q & A.

It is possible to request both styles of transmitters on the same frequency, for use with a single receiver.

Note that you cannot utilize two transmitters on the same frequency at the same time. When two transmitters are operating simultaneously, the result is not a blending of the audio as some would expect, but rather a jamming of each other's encoded RF transmissions.

ENG vs. Studio:

ENG receivers are designed for field or camcorder use and have been miniaturized and designed for internal battery power and portability.

Studio receivers intended for theater or concert performances may require 120v AC and tend to be physically much larger. They range in size from a small textbook to rackmount. These slightly larger units may have the advantage of more sophisticated front end filtering to reduce interference, and often feature diversity antenna systems as well. Rack mount units, because of their

better front end filtering, are preferred in situations calling for a large number of radio units to operate simultaneously.

The smaller ENG units sacrifice some of the more exotic front end circuitry in order to achieve compactness.

VHF vs. UHF:

VHF professional wireless mic frequencies (169-210 MHz) overlap the standard television channels 7 thru 12, as per FCC regulation. That means that many radio mics will only operate interference free in some cities, dependent on the local TV channel line-up.

VHF units tend to offer slightly greater range, longer battery life, lower purchase price, but are more susceptible to interference.

There are a handful of legal frequencies just under channel 7, roughly 169-174 MHz, referred to as “A” frequencies or “travelers”. This narrow range of frequencies will work in roughly 90% of the cities nationwide.

UHF frequencies are much higher up on the spectrum, up in the same range as UHF television channels. UHF’s tend towards less working range than VHF (although some of the better UHF units have amazing range), higher battery drain, much more expensive manufacturing costs, but are less prone to basic interference. However, the new appearance of HDTV transmitters is beginning to takes its toll on available UHF airspace.

The majority of radio mics used in our industry are UHF, and most of the manufacturers are phasing out their lines of VHF wireless systems.

Single antenna vs. Diversity:

Many inexpensive ENG receivers utilize a single receiving antenna, which is adequate for most short range, line-of-sight applications.

Diversity systems deploy two antennas, and internally switch back and forth to whichever antenna offers the better signal. Antenna Diversity systems compare the RF signals from each of the antennas, and switch to the stronger signal. True Diversity systems have dual processors that convert the RF signals to audio, and then switch between them.

The advantages of diversity include less likelihood of RF dropout due to the direct or reflected signal paths being obstructed, as well as increased working range (based on the antenna placement). The disadvantages of diversity can include having to deal with two antennas; audibly recognizable “switching” (a trait more common in the cheaper systems); and the chance of one of the two antennas locking onto interference. But the advantages tend to outweigh the disadvantages, so the majority of professional wireless in use today are diversity!

Some mixers prefer to remove the antennas from the diversity receiver and connect them via a short length (5 to 25 feet) of RG-59 antenna cable in order to extend the range and increase the likelihood of one or the other receiving antenna finding a clear signal.

Fixed frequency and frequency agile:

One of the constant risks when using radio mics is that someone or something at the production location may be transmitting interference on your frequency. This interference could be: another user in the immediate area; electronics; walkie-talkies; paging systems; remote controllers; or radio-television signals.

The only way around this interference is for you to change frequencies. If your wireless system is a single, factory assigned fixed frequency -- then you have to change radio mics. (You were warned to always bring along a spare!)

However, some of the newer wireless systems on the market offer multiple, user selectable frequencies. Systems offering from 10 to 200 built-in frequencies are not uncommon. Most of these frequencies are pretty

close to each other (compared to UHF TV stations), and may encompass 30 or 40 frequencies per each TV channel. But there is usually enough spread to move you into another TV channel, or far away enough from another user to avoid the interference from other radio mics at the same venue.

A quick and easy way to check for the presence of possible radio interference is to activate only the receiver portion of your wireless and to watch the RF indicators (that normally show signal strength of your transmitter). If the LED's show that a signal is present, and YOUR transmitter is OFF -- that is a good indicator that something else is broadcasting on your selected frequency! Change to another frequency and see if the RF presence goes away.

Quad-Box:

A quad-box consists of four individual ENG sized receivers, non-permanently housed in a compact case. The case includes an antenna “splitter” (RF distribution amp) so that one single antenna (or two for diversity units) provides the feed for all four receivers. Most quad-boxes also feature a centralized battery power supply that will “externally” power all the receivers.

Quad-boxes are convenient. Their only drawback is that sometimes better performance can be achieved by separating the receivers and placing them strategically closer to the action. Receivers may be placed in different sites to optimize antenna line-of-site for each actor in the scene.

Rigging the Talent

Attaching the body pack transmitter:

Hiding the transmitter under the wardrobe of most male performers is usually fairly simple, due to the fact that men generally wear looser fitting clothing. Bulging pockets are common: stuffed with wallets, keys, handkerchief, comb, coins, etc. The presence of a small transmitter case rarely upsets the visual lines of the fashion.

Where the transmitter will be hidden is dependent on a couple of factors, such as the physical actions or stunts, and the contours of the wardrobe. Common sites for the transmitter include: inside the waistband of trousers, and the inside pocket of a jacket or sport coat. Other sites are: inside the trouser leg, under the armpit (like a shoulder holster), across the small of the back, high up inside the thigh, or even inside of a hat.

A safety pin can be attached to the transmitter by means of tape or a thick rubber band, allowing the transmitter to be easily pinned onto wardrobe.

ACE bandages are another convenient way of securing the radio mic.

Professionals usually carry a variety of custom elastic belts and cloth pouches (such as those made by Equipment Emporium) to facilitate rigging. The transmitters fit inside of the pouches, which can then be pinned directly to clothing or slipped over thin, lightweight elastic belts. The Velcro closured belts can be worn around the waist, thigh, etc.

A couple of quick notes about belt and pouch kits. The belts should be thin; porous if possible. Velcro and elastic can cover a wide range of sizes White usually conceals easier than darker colors. Very importantly, keep the belts freshly laundered.

Hiding the transmitter on a female is often more complicated, due to the differences in fashion. Whereas men’s clothing is commonly loose-fitting and lumpy, women’s fashions tend to be closely contoured to the body.

A variety of elastic belts are much more important, since the thinner fabrics may not support the weight of a pin-on transmitter.

Choice of sites are based on wardrobe style, camera angle, and physical action.

Places to rig transmitters on a female include the small of the back (waist belt), the backstrap of the bra, upper back (X-shaped rig), under the arm, on the inside thigh (intimate, but works for short, tight fitting skirts), the back of the neck (under long hair), inside a leg warmer, under a hat, or even under a wig.

Be considerate of talent's privacy when preparing to rig them. Don't advertise all over the set that you are about to hide a transmitter under someone's clothing! Offer to invite a "chaperone" to accompany you both in the dressing room -- but phrase it in a "friendlier" way, by suggesting that someone could fix her hair or run some script lines while you rig the radio mic. ALWAYS bring a chaperone if you are working with a minor! You might also consider training someone of the opposite sex to help you out.

Avoid the use of camera or gaffers tape directly against the skin. Use some sort of cloth liner, first aid gauze, or even toilet paper to protect the skin from these tapes.

If you are in a situation that requires taping directly to skin, then use a medical surgical tape designed for that purpose, such as 3M Micropore Action tape. Remember to clean the surface of the skin first with an alcohol pad, in order to remove oils and dirt.

If there is a likelihood of the transmitter getting wet (from rain, water spray, or heavy perspiration), use two dry condoms to protect the electronics. Cover the transmitter bottom-to-top and then top-to-bottom to shield it from water droplets.

Antenna considerations:

A prime consideration when selecting the body site to hide a transmitter is the antenna path. We want the transmitter antenna to have optimum "line of sight" to the receiver antenna.

If talent will be sitting on a metal backed chair, it would be a poor choice to have the antenna running along the back, say from waist to shoulder. Similarly, if talent is facing up against a metal filing cabinet, then we would try to avoid rigging the antenna along the front.

Body pack transmitters either utilize an antenna separate from the mic line, or they integrate their antenna function with the ground wire of the mic.

Separate antennas offer greater control over the antenna path. We can rig the antenna solely on the basis of best line of sight. Longer VHF antennas should be kept somewhat taut, with just a little slack, which is best done by attaching a rubber band and safety pin to the end. The pin is secured to clothing, and the rubber band acts as a strain relief as the actor moves or bends. The antenna should not loop over itself. If the best antenna placement is downward, then invert the transmitter rather than bend the antenna. (Shorter UHF antennas are usually rigid enough to keep their shape without assistance.)

A flexible or soft antenna can be kept somewhat vertical (either upward or downward), or can be angled horizontally from the transmitter up to 90 degrees. If the transmitter antenna is angled, sometimes reception can be improved by tilting the receiver antenna to match.

No antenna should ever cross over the microphone line. It is okay for the mic line to loop over itself (as when the transmitter is inverted). Always run the mic line and antenna away from each other; flip the transmitter if necessary so that the lines do not cross each other.

Moisture will absorb RF energy, and thus weaken the transmission. A rubber sheath of shrink tubing, fuel line, or surgical tubing can help isolate the antenna from excess perspiration, rain, etc.

The drawback to separate antennas is that they are an additional element to rig and hide.

However, the disadvantage of combination antenna/mic lines is that the mic line must be cut to specific (antenna) length, and that the best mic path is not always the optimum antenna site. Greater care must be taken to keep the mic cable as straight as possible. Avoid bunching up the mic/antenna line and "stuffing" it into a pocket or under a waistband, since this will reduce the transmission signal.

Receiver Antennas:

Good antenna placement is the key to eliminating drop-outs and reducing the chances of interference. Keep the antenna path as short as possible, and transmit through as few obstacles as possible.

Place your receivers as close as you can to the actors. Receivers can be just on the edge of the set, or even hidden within the set. It is more efficient to run a long length of audio cable from the receiver back to the mixing panel than to run a long antenna cable.

Think in terms of clean line-of-sight. The best place for your sound cart may not be the best place for your receivers! The antennas might have a cleaner path coming in from the side or rear of the set as opposed to threading their way through (crew) bodies, metal stands, power cables, and other electronic obstacles in the path back to your audio encampment.

Mounting your antennas high helps them to see over obstacles such as bodies and grip stands.

Be very careful when mounting receivers onto camcorders. Make sure that the antenna does not have to "see through" the camera body or VTR. Be aware that a lot of RF interference can be generated by the video recording heads, and the viewfinder.

I have found that when mounting small, inexpensive receivers (such as the Audio Technica Pro88) onto the shoe brackets of prosumer miniDV camcorders, it is better to rotate the receiver so that the antenna faces the forehead of the operator rather than being located directly above the electronics of the viewfinder.

There are different types of receiver antennas.

The most common antennas that come with wireless mics are the stiff wire "whip" antenna and the short rubber sheathed helicoil "rubber duckie". The stiff wire antennas are the most efficient, but may not be practical in an ENG situation. The rubber duckies are safer and more portable, but lose a little in terms of range.

Early ENG style receivers sometimes came equipped with a limp wire antenna, similar to those found on transmitters. The limp wire antenna is inefficient unless it is kept taut. Compared to the wire whip or the popular rubber duckie, the limp wire is a poor choice.

Antennas as accessories:

Ground plane antennas look like little camera tripods and are designed to take advantage of "ground plane" reflections, sort of the way a pressure zone or boundary plate mic uses a hard surface to gather sound. Ground planes work very well for stage shows and the like.

However, most field production involves a lot of electromagnetic equipment (lighting units, ballasts, coils of electrical cables) strewn on the ground in their path, so ground plane antennas would not be my personal choice.

"Dipole" antennas look like two wire whip antennas mounted back to back, in a vertical configuration. They achieve "higher gain" by polarizing incoming signals (sort of like sunglasses). Radio signals that strike the antenna at ninety degrees (horizontal) are passed with greater efficiency than spurious signals bouncing all over the place. In a sense, these two-element dipoles are 'directional' in that they see a single plane (picture Saturn's rings).

Dipole antenna systems are very popular on professional motion picture sets.

The **yagi** type of antenna resembles a two dimensional Christmas tree. It is a smaller version of household rooftop TV antennas. The yagi works like a shotgun mic. It is very directional and needs to be aimed towards the transmitter. They are also very common on professional sets.

General concerns with wireless mics:

Don't expect miracles. Even the best Hollywood sound mixers have to wrestle with their wireless.

The range is never what you expect nor what the spec sheets claim, because you will not be operating in a perfect environment.

If you need increased range, try utilizing a dipole or yagi antenna system. You can request them when you rent or purchase your wireless. If the salesperson doesn't know what you are talking about, go to a real sound house run by mixers!

Another way to increase your range is to shorten the distance between the transmitter and receiver. Have someone carry the receiver and *walk* the distance parallel with the actor.

The more units that are working simultaneously, the increased likelihood of them interfering with each other. Actors passing close to each other may generate a buzz. If you know that actors will be working close, assign them units on frequencies as far apart from each other as possible. Think carefully before you just grab a radio mic and stick it on someone.

Check your batteries often. Weak batteries in the transmitter or receiver are the main cause of problems.

Periodically re-check your transmitter rigging. Actors have a tendency of adjusting their wardrobe, and upsetting your carefully positioned mic and/or antenna placement.

If talent will be perspiring a lot, or working in rain or near water, then it is a good idea to encase the body pack transmitter in a protective condom and seal it with electrical tape. Use standard non-lubricated latex condoms. *But don't forget to warn your personal mate as to their professional use, lest they be discovered when you get home!*

Don't place receivers too close to mixing panels or video monitors. There is often an invisible wall of electromagnetic energy within a couple inches of some electronic devices. If you use the frail output cables that come with some wireless receivers, either the receiver itself or the (inadequately shielded) thin cable may be in direct contact with or merely too close to the magnetic fields. Employ a short, high quality, properly shielded XLR mic cable to achieve at least a foot or two of separation.

Select your lavaliers with care. Don't just concern yourself with the performance of the transmitter and receiver, but remember that the properties of the actual microphone capsule has a lot to do with the characteristics of the final sound. Do you need a proximity lavalier to hold back surrounding noise, or would a transparent lavalier intercut with your other mics better? Many of us go out into the field with an assortment of mics that we can use on our wireless, so that we can choose the right mic for any given situation.

Learn how to adjust the mic sensitivity of the transmitter. Not all mics put out the same volume; nor do all actors speak at the same level. Tweak the mic level setting on the bodypack so that you are working toward the lower end of the scale, so to speak. Turn it all the way down (almost no volume) and then bring it up until the mic begins to sound clear. Go up just a smidge more, and then stop. This sets the mic loud enough to be crisp, but still low enough to allow some dynamic range in the actor's performance before the automatic gain controls/limiters of the transmitter kick in and squish the signal.

If you need more overall volume back at the mixer or recorder, then turn up the RECEIVER output level. And make sure that you have the receiver output signal (which is almost always a mic level signal) going in to a mic level input and NOT a line level input.

A way to get emergency volume out of some cheap consumer grade radio mics is to use the headphone output (instead of the official mic out) and bring it in as a LINE level input on the mixer.

Clothing noise:

Wireless transmitters do not suffer from clothing noise. However, the lavaliers plugged into them certainly do!

Rig your lavaliers the same as you would if they were hardwired.

For the benefit of readers who missed the article on lavalier mics, here are a few pointers:

Make a small loop near the mic capsule. Secure the loop loosely with a piece of thread or a thin strip of camera tape (sticky side out). The loop should be able to freely open and close if the cable is tugged. This loop serves to cancel out most cable noise conducted along the rubber sheath of the mic cable.

Eliminate contact clothing noise by securing the wardrobe on both sides of the mic capsule. If the clothing is not free to rub against the mic head, then there won't be noise.

A popular technique is to sandwich the mic head between two sticky triangles made from camera tape. Start with a two inch long strip of (one inch wide) camera tape, and fold it corner over corner like a flag, sticky side out. Make a second triangle the same way. Then sandwich the mic between them, being careful not to block the grill.

In the case of a button down shirt or blouse, attach the sticky triangle onto the fabric overlap, just above one button. Let the tied off loop hang opposite of the button. Secure the next inch or two of mic line with a simple strip of camera tape along the overlap, running vertically downward towards the next button.

Any tugging on the cable will be strain relieved by the section taped to the clothing. The floating loop will isolate the mic capsule, and the twin sticky triangles will prevent clothing from rubbing across the mic itself.

Wiring a female can be simpler. If she is wearing a bra, arrange the triangles over the mic so that one point is down. Secure the mic inside of the bra, at the “cross your heart” juncture in the center of the bosom. A small strip of surgical tape can be used to anchor the mic cable along the upper abdomen.

The natural swell of the bosom protects the mic from clothing contact, as well as positioning it out from the chest cavity.

Clothing noise can also be acoustic in nature, and is created by clothing fibers rubbing against each other. Starched clothing is very noise conductive, so soften the cloth with a light mist of water wherever the camera won’t notice it, such as under the sports coat. Soften a patch of clothing around the site where the microphone is to be attached.

Combat noise from clothing friction with Static Guard.

Wind noise can be alleviated by salvaging the foam tip from a (used) video cleaning swab. Pull the tip off of the stick, and slice the base off. What remains is a foam hood that will slip over most lavaliers.

These free windscreens can be painted with marking pens to be less visible. And since they cost nothing, there is no risk of sandwiching them within tape that would destroy the foam upon removal.

Additional wind protection can be achieved by wrapping some cheesecloth over the mic. Cut off the fingertip from a pair of child’s or woman’s knit gloves, and pull that hood over the mic and cheesecloth.

Another useful trick for rigging lavaliers is to use moleskin and safety pins. This technique is particularly effective when you have to wire talent quickly, or if talent is going to be very physically active and might otherwise dislodge a taped on mic.

Wrap a layer of soft moleskin around the head of the mic. Insert an open safety pin, and then wrap another layer to secure it. The lavalier is now ready to be pinned in place under wardrobe. The moleskin tends to insulate the mic capsule from most clothing noise. An additional strip or two of tape or moleskin can be added to help prevent clothing from rubbing against the mic, and to strain relief the mic cable.

Introduction to Mixing Panels for Production Sound

Why use a mixing panel?

Depending on the type of production that one does, there are two basic reasons to use a mixing panel: **remote control** or **complete control**.

In the case of ENG production, cinema verite, or "run & gun" documentary – the mix panel serves as a **remote** input system for audio recording. By this, I mean that the mixing panel is an extension of the camcorder, allowing the soundperson to access the mic input controls (volume) of the camcorder without having to push aside the camera operator in order to set microphone input levels or to ride gain (volume) during a scene.

In addition to giving the soundperson control of the mic levels — the over-the-shoulder ENG mixing panel allows the deployment of multiple mics (usually up to three or four), along with Phantom powering, and headphone monitoring.

The ENG mixers may also offer amenities such as a slating mic, line-up tone, low-cut filters, limiter, and pan pots. Powering of the mix panel is from internal batteries, such as 9v alkalines or rechargeables.

Specific features will vary, of course, from model to model.

Popular, broadcast grade ENG mixing panels include the Shure FP33 and the Sound Devices 442.

The other class of mixing panels that I mentioned in the beginning of this article is the **location console**, so to speak. These mixing boards are not over-the-shoulder portables, but are used off of a location soundcart or tabletop. Most of these boards require AC powering, although some of the higher end models can run off of internal or external 12v batteries.

What makes this group of mixing panels different than their ENG brethren is that they offer complete and smooth control of the audio inputs and outputs. This advanced control of the signal is essential in professional theatrical film/video production.

The mixing panel has more elaborate input modules that offer balanced XLR inputs, mic powering, trim pots, low cut filters, equalization, solo PFL, pan pots, channel assigns, and smooth faders. Outputs include main outs to the recorder, headphones for the soundperson, outputs for Director/Script, and a way to send audio to the boom operator.

Whether you are using only one mic, or several, the mixing panel gives you maximum and consistent control over your signal. Considering that recording media are in a state of constant evolution, it is important to work from a board that will remain constant regardless of whether you are ultimately recording onto a Nagra, Nagra stereo timecode, DAT, video deck, minidisc, hard-drive recorder, or whatever the next NAB Show may bring.

Basic operation of the

ENG mix panel

The majority of ENG mixers are simple and straight forward in their operation.

The most important thing is to make sure that your batteries are fresh. Most mixers can only run one or two days at most on a set of batteries.

The inputs are generally on the side of the unit. There may be a switch for selection of mic or line level input.

Phantom powering is often selected by a dip switch or toggle, located either in the battery compartment or along the outer spine.

Each mic input has a volume control (gain pot), along with a pan pot to assign the sound to left/right or somewhere in between. If the tapes are going to be painstakingly edited, it may be better to assign the mics to **only** left or right tracks, and let the editor do the "panning" during post-production.

The gain pots of a mixer offer smoother control over the dialog than if you plugged directly into the camera. On the camcorder, even a small adjustment of the input knob will result in a coarse and drastic rise or drop in level. Riding gain during a dramatic passage is virtually impossible. Mixing boards, on the other hand, provide mic pots that are ramped or sloped so as to permit much more subtle level changes.

A master gain control will raise or lower the overall level of your incoming signals. On some mixers, such as the Shure, the master gain also sets the reference tone level. You do not need to leave the master set at the same level that you used for zeroing the tone. Once the tone has been recorded, feel free to make use of the master to keep your levels optimum without having to turn your mic inputs to extreme.

Low cut filters reduce the effect of wind noise, rumble, and vibration. They are most useful out of doors, where ambient noise is at its worst. However, some of the low cut filters on ENG panels tend to be pretty severe, so use them sparingly lest they cut into the quality of the voices too much. Pay attention to **consistency**, so that all of your scenes that intercut will match up.

Some panels offer a limiter that will catch and compress any loud outbursts that may have gotten past the soundperson's manual control. This keeps the signal from overmodulating and distorting in the camera. Depending on the aggressiveness (threshold) of the limiting circuit, some people prefer to leave the limiters off and do it all manually rather than suffer the consequences of automated "pumping".

Outputs of the ENG mixing panels are usually selectable for line or mic level. Whenever possible, use the line level output of the mixer plugged into line level input of the camcorder. Line level is a much stronger signal and less susceptible to electronic interference in the environment.

Not all camcorders will accept line level, particularly the prosumer models. If your camera only takes external mic input, then make sure to use mic level output from your mixer, or a suitable adapter cable to take the signal down to mic level. Feeding a hot line level signal into a mic input will yield distortion and break-up.

Bear in mind that the metering system on your ENG panel may be scaled differently than that on your camcorder. Zero VU is not the same as zero digital. If your camcorder has a VU type meter, then start out by setting a zero tone from the mixer to zero level on your camcorder. Record a series of tests, and then playback the video to determine where distortion sets in. You may find that you need to compensate by going from zero on the panel to, say, nega-

tive three or negative five on the camera. (Regardless, you would still record your color bars & tone at zero level on the camera).

If your camcorder is digital (highly likely these days), then you will have to experiment to figure out the correlation between the mixer and the camcorder. Traditionally in digital recording, zero VU would equate to anywhere from negative 15 to negative 24 on the digital scale. But camcorders are not known for their precision in metering. I would suggest feeding some normal dialogue into the camcorder (not exceeding zero VU on the mixer) and setting the camcorder to automatic audio level. Watch to see where the camcorder puts the dialogue. Then match that approximate level setting when you switch the camera back to manual.

Some ENG soundpeople employ what is known as a "video snake" to connect their mixing panels to professional camcorders. This consists of a 15 to 25 foot multiplex cable (3 or 4 balanced mic cables in one sheath) that includes two balanced XLR mic cables to send the audio to the camera.

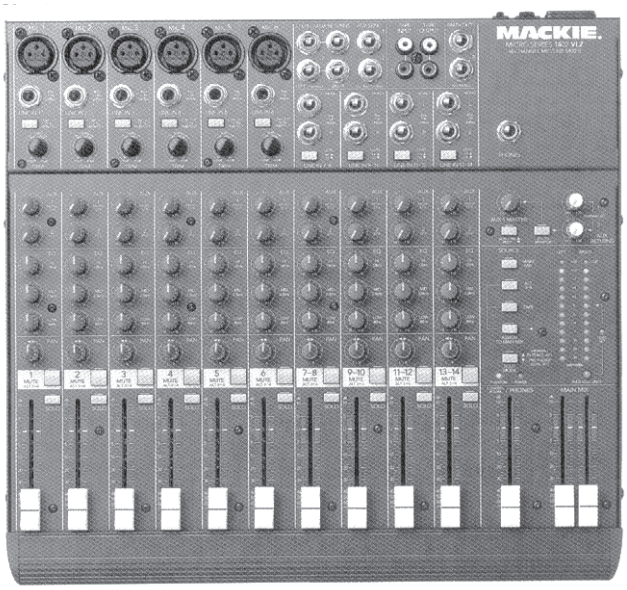
A third line (stereo mini connectors) brings return audio from the camcorder (headphone) back to the mixing panel. ENG mix panels usually have an input for audio return, so that the soundperson can verify that audio has made it cleanly to the camera.

A multi-pin connector in the single cable near the camcorder allows the soundperson to quickly disconnect or reconnect.

Basic operation of the Mackie 1402

Mixing panels are like automobiles. Once you learn how to operate one model, you discover that other makes and models are fairly similar. Some of the buttons may be in different places, but the operating principles are pretty much the same. Because of its layout simplicity, wide acceptance by the professional industry, and affordability – I have chosen to use the 1402 as our working example.

The Mackie MS1402-VLZ (trademark of Mackie Designs Inc) is one of the finest little mixing boards available for under several thousand dollars – which is even more



incredible considering that the board sells for under six hundred dollars!

This board (and its bigger brother, the 1604-VLZ) is frequently used by Production Sound Mixers on 35mm features, episodic television series, commercials, and all variety of professional film and video productions. It is a real workhorse of a unit in terms of audio quality and overall field performance, and — except for lacking a few bells & whistles — very much the equal of higher priced boards

Powering

The 1402 is designed to operate from regular 117vAC wall power. The manufacturer made no provision for internal battery operation or external 12 volt DC. However, it is extremely rare that you would be shooting a dramatic scene or major interview on a set where there was no AC power for lights, monitors, etc.

In the event that you are in a remote location that does not have any electricity available, the 1402 can be operated via a common 150watt inverter that converts 12vDC (cig lighter or camera battery) to AC.

Some people complain that when the Mackie is run off of the inverter, a little bit of buzz & hum is detectable in the headphones. Personally, I have found that this electronic noise is only noticeable when the mic inputs are turned all the way up (with no mics attached) and the headphone volume is all the way up.

Under actual working conditions, with a mic plugged in, the noise is so low as to be undetectable. Especially in noisy exteriors, such as beaches or mountain tops.

The power switch is on the back. Remember to turn it on.

Inputs

The 1402 has 6 XLR low impedance, balanced mic inputs; plus 4 more stereo/mono ¼-inch line inputs. Six mic ins are plenty for most productions.

48volt Phantom powering is available for the XLR mic inputs. A switch on the back activates Phantom powering for all 6 of the mic inputs.

Each input module is referred to as a "channel strip".

Below each XLR mic input is a ¼-inch jack for line level input.

On the 4 sets of line inputs, you can plug in mono or stereo sources. A mono signal plugs in to the Left jack. A stereo source plugs into the left and right jacks, and both sides of the signal are uniformly controlled by the EQ and fader.

Unless you are miking a panel discussion or musical variety show, you probably won't need more than six mic inputs for film/video work. The only time I have needed more inputs on a theatrical produc-

tion was when I had a lot of radio mics working in addition to my wired microphones. Some radio mics give you the option of mic or line level output, so you may be able to use them in the line inputs of your board.

There is a button on each strip for low cut. Using these buttons allows you to cut the low frequencies consistently, rather than dialing in a variable amount of bass cut with the equalizer controls. My recommendation is to use the low cut buttons on your mics during exterior filming, and leave the buttons off during interiors. But if you use a panel that does not have a low cut button, use the EQ knob but be precisely consistent on where you set it, so that your takes will match from day to day.

Each XLR input has two controls for the volume: a trim pot and a fader. The trim pot serves as a coarse adjustment, and the fader allows more subtle control. Use the trim pot to adjust for mic sensitivity and vocal intensity (whisper or loud voice). Leave the fader at the Unity position ("zero" setting, about 2/3 up) and adjust the trim for an "okay, in-the-ballpark" level.

By using the individual trim pots, all of your mic inputs can be roughed out so that all of your faders go to the same height when your mics are open, eliminating the need to tape marks alongside the faders to indicate optimum setting for each actor. It sure beats the old way of having all of your faders open to varying heights and trying to keep track of them during rapid changes.

Equalization

For each input, there are 3 channels of equalization that allow you to increase/decrease low, middle, and high frequencies. Use your EQ sparingly and carefully, because you cannot un-do those changes in post-production.

Low frequencies often affect noise such as wind, traffic rumble, and vibration. But it may also take the bottom end out of speech, so be careful. I like to roll off a fair amount of bass on my exterior shots, and take out just a little from interiors. If your microphone has a low-cut dip switch, that is sufficient for interiors. The low cut button is a more consistent way of reducing bass than using the EQ knob.

Middle frequencies cover most of human speech, so a slight increase of mid-range can help to improve clarity. If you choose to use a slight mid-range bump, be careful to use it consistently (in other words, all the time). Otherwise, play it safe and leave the mid-range alone.

High frequency adjustment is rarely needed. Leave it alone.

The time to employ your EQ settings is when you need to match secondary microphones to your primary mic.

Let's assume that most of your show is being covered by a shotgun mic on a boompole. That makes the sound from your boom the basic tone of the dialog. That tone should be clear and natural. Almost no EQ, except for some bass roll-off during exteriors.

In some scenes, you need to deploy additional microphones, such as a second boom, lavalier, or planted mic. Obviously, the tone of these other mics may be different from your main boom mic.

That is when you would use the EQ knobs! Try to make the other mics match the main microphone. But be careful not to overdo it.

If in doubt, leave the EQ knobs alone and let the re-recording mixers fix it in the final mix. Any changes that you make in the field cannot be undone later, so only attempt what you are confident in doing.

Sometimes, and I emphasize that this happens very rarely, a qualified sound mixer will use the EQ settings to filter out an offending noise on the set. It is difficult to filter most noises out, since they usually overlap the same frequencies as dialog. Very few environmental noises are limited to a narrow frequency.

When you use the EQ to reduce a noise, you also take a slice out of the dialog, so be very careful. Only try to remove noise if the take has to stand on its own (bare bones editing; not going to a mixdown) or if the noise is so bad that the scene will probably end up being looped (so you have nothing to lose by screwing up).

To use the EQ for reducing noise, first try to isolate the frequencies by amplifying the noise. Turn the EQ knobs louder to make the noise as prominent as possible. Now you know what settings affect it. Now, turn the EQ to negative settings to minimize those offending frequencies.

Aux 1 and 2

On each input strip are two knobs for Aux channels. Aux is like having a second mixing panel within your main panel. The Aux knobs determine how much signal from each input are sent to the main Aux Outputs.

PRE FADER means that the signal is controlled by the Aux knob and is not affected at all by the fader. It is like having two separate mix boards.

For example, one mix could feed the PA system of an auditorium while the other mix could go out to the recorder. This would be handy when you didn't want to have some mics generating loudspeaker feedback, or if some musical instruments were so loud that they didn't need to be amplified by the house speakers.

POST FADER means that the Aux knob takes effect after the signal has been controlled by the fader. If the fader were closed, then no signal would go to the Aux. The Aux output reflects any changes in volume made by the faders. But if the fader was open, and the Aux was closed, then no signal would go to the Aux output.

POST FADER Aux is used during production as a convenient way to send audio to the boom operator. The output of all of the Aux 1 knobs is controlled by the Aux 1 Master knob.

Use the Aux Master to control the volume of the boomperson's headphones.

If you have a tone generator plugged in to one of your inputs, then turn the Aux 1 knob down on that input so it won't blast the ears of your boom operator.

Audio to the boom operator

Plug the output for the boomperson's headphones into the main **Aux Send 1**, which is a ¼-inch jack. Use a ***¼-plug to XLRmale*** adapter cable, and then run an XLR mic cable back to the boom operator. At the boom operator's end, there is ***a ¼-inch jack to XLRfemale*** adapter (or belt box), to accommodate headphones.

On a professional set, we use a custom duplex cable that does the same thing in a neater package. At the mixer end are two XLR connectors – one to carry the audio from the boompole and another to send a headphone feed back to the boomperson. Both audio lines are packaged in a single

housing, so there is only one physical cable linking boom to the mixer. At the boom operator's end there is a breakout box that includes an XLR female connector (for the boom mic) and a headphone jack. Some boxes even have a volume control for the headphones. These cables are anywhere from 50 to 100 feet long, with 75 being the most popular length.

It is also possible to use a radio mic or wireless assistive listening system (such as Comtek or Listen Tech) to transmit audio back to the boom operator.

If the sound mixer is monitoring out of the Nagra or other recorder, then you could plug the boom operator into the regular headphone jack of the mix panel.

Pan

The last knob on the input strip is the Pan pot, which sends the signal to the left, right, or anywhere in between. Use it to assign the input signal to a specific track if you are recording in stereo (2-track).

In the case of the Nagra 4.2, which is a mono recorder, it makes no difference, so you might as well leave the tracks centered.

If you are recording onto a 2-track recorder, then it is better to assign your inputs to complete left or right, but not a centered mix of both at the same time. Otherwise, you cannot deal with the 2 audio tracks separately during post.Mute

Mute "kills" the audio of an input and removes it from the main outputs. In the case of the Mackie, it actually re-routes the audio to another set of outputs, labeled Alt 3 &4, so that you can still record these signals onto a four-track recorder. Comes in handy if you want to record scratch tracks, interview questions, or other material that you prefer to keep out of your main mix.

Solo

Depressing the solo button allows you to monitor only the selected input in your headphones. This is very useful for troubleshooting and checking mics.

Pre fade listen (PFL) means that you can listen to an input even if the fader is completely closed. It is good for cueing up a playback, or checking on a microphone.

Headphone Monitoring

Stereo headphones plug in to the phones jack on the upper right of the panel. The sound mixer should monitor directly out of the recorder whenever possible, in case something happens to the signal after it leaves the panel. Connections may get undone, radio stations can cause interference, recording levels get accidentally changed at the recorder, and so on.

It is possible to monitor the recorder FROM the mix panel by bringing a return audio signal into the TAPE IN jacks (RCA connectors). There are buttons that allow the headphones (and Control Room jacks) to monitor the Main Mix (standard setting), Alt 3-4 (the mute buttons), or TAPE (return from recorder, or an additional line input source).

Alt 3-4 and/or TAPE (when this is a fresh source and NOT the return audio from the recorder) can be added to the Main Mix with a button, but that is for more advanced applications and not recommended for the novice.

Audio for Director, Script, and Others

It is a common practice to provide audio to key people on the set in addition to your boom operator. Use some sort of wireless system in order to avoid cable confusion. Besides, it is highly unlikely for your Director to stay in one spot very long!

The wireless can be fed from the TAPE OUT (RCA jacks), Control Room outs, Main outs (you have XLR's on the back as well as ¼-inch on the top), or Aux Send. Lots of choices…

Output to the Recorder

As mentioned above, there are numerous ways of getting signals out of the mix board. The best method is to use the XLR balanced outputs on the back of the board.

For example, if you were recording with a Nagra 4.2, you would plug theXLR female end of an adapter cable into the XLR male output connector of the Mackie. The other end of this adapter cable would be a pair of banana plugs, and those would go into the LINE LEVEL INPUT of the Nagra.

For other recorders, you would use an adapter cable with the appropriate connector for that device.

Whenever possible, use the line level output rather than the diminutive mic level option, since it takes a lot stronger signal to cause interference at line level.

However, if your camcorder only accepts external MIC input, then be sure to depress the button near the XLR outs that will reduce the outgoing signal from line to mic. Another trick for feeding camcorders is to feed them from the Aux output, since you can easily reduce the signal with the Aux individual or Master controls. If you don't mind giving up control over your headphone level, you could use the Control Room outputs (level managed by the headphone fader).

The ¼-inch outputs of the Mackie can be used as balanced as well as unbalanced out. If you use a stereo plug (tip/ring/sleeve) the output can be balanced. A mono ¼-inch plug (tip/sleeve) will give you unbalanced.

The TAPE outs are convenient unbalanced RCA outputs, and may be convenient for some applications.

Metering

The LED meter on the Mackie is a more of a peak reading meter, similar to that of the Nagra, than a typical VU meter as found on most other brands of mix boards.

Although one usually goes from 0 VU on the mix panel to –8 dB on the Nagra — in the case of the Mackie, it would be okay to go from zero to zero on the Nagra.

The most important thing is to check where your mic levels play on the Nagra's meter. If a solid signal on the Mackie meter shows as too hot (or too low) on the Nagra, then simply re-adjust the line level input knob of the Nagra!

This look and see approach applies to other recorders as well.

All meters read and react differently to dialog, so don't be so rigid in your ways that you fail to compensate. The only meter that really matters is the Recorder's!

Unfortunately, the Mackie does not come with either a slating mic nor an internal tone generator. Use the slate mic for voice slating scene/take numbers, or for communication to your boom operator. Use tone to line up your mix panel meter with that of your recorder.

Fostex makes a nifty tone generator known as the model TT-15, which is a unit around the size of a pack of cigarettes. The TT-15 has mic and line output, so I prefer to feed the tone at line level into one of the unused ¼-inch line input strips of the Mackie. As for a slating mic, well, just stick a lavalier into any of your unused XLR inputs and you're in business.

Consistency in Production Sound Recording

A critical aspect in sound recording for motion pictures and video is the consistency of all of the repetitively appearing elements of the soundtrack from scene to scene. As a scene (or an event in time) progresses from beginning to end — audiences expect the sound to flow seamlessly and continuously, just as it would if they were somehow physically present while witness to the event.

It does not matter to the audience that we have constructed this cinematic event from numerous camera angles and takes, shot over a wide expanse of actual time. On screen, it all becomes one continuous mise en scene. Actors walk & talk and progress from point A in their fictional time to point B, without delay nor interruption. That is, until the scene changes. Not merely the angle, but the scene!

Imagine that you are in an apartment and eavesdropping on your roommates. You make a pretense of moving around in order to houseclean, but really you are just trying to be inconspicuous while you watch and listen to their conversation. As you periodically change your location in the room while in the act of tidying up, you are really just editing your viewing angle of the action. But even as you change you visual vantage point, or mentally focus in (zoom) on one roommate or the other, the sound remains pretty much the same.

The audio elements within the scene normally include dialogue between two or more characters, background noise, and spot sound effects.. The audio levels between the actors will vary in relation to each other; different people do not speak at the same level nor with the same intensity. But real people will not change their individual speaking levels arbitrarily, suddenly shifting from whispers to shouts to normal to whispers to normal to shouts without extenuating dramatic rationale. The ring of a telephone or the slamming of a door may shatter the monotony, but the drone of the traffic outside the window remains fairly constant.

To achieve this realistic consistency of the audio is the combined goal of the entire sound team, including the Production Mixer, Sound Editor, and the Re-Recording Mixer.

This article will deal with consistency as it pertains to the role of the Production Sound Mixer.

There are three aspects of consistency that the Mixer must be attentive to: 1) Consistency within the shot; 2) Consistency between shots within the scene; and 3) Consistency between scenes.

Within the shot, levels should remain relatively constant between actors and also between background ambiance. Actors are not expected to match each other in terms of recording level; variations are normal. But their levels should match themselves. As they banter, the actors' audio should appear somewhat constant. There should be no unwarranted sudden changes in volume, except when justified by dramatic intent.

For instance, actor A (Tough Guy) usually speaks loud and forcefully. Actor B (Mousy Nerd) is far more timid and soft-spoken.

If we are recording on a Nagra, we try to keep normal conversation at around minus 6 or so on the meter (which is a peak reading meter). The area around zero is reserved for shouts and loud sound effects. Recall that when using a peak reading meter such as that found on the Nagra, a level of minus 8 is the rough equivalent of zero on a VU meter.

Peak meters are calibrated in terms of measuring the loudest part of the signal that can be recorded onto the tape without risking distortion. It is like reading a 100% white level. VU meters are set up in terms of average volume levels, and assumes approximately ten dB difference between the average level and maximum. It is like reading a middle gray level. Zero VU (middle gray) is equivalent to minus eight or ten PEAK (white). Our industry, for the sake of convention, considers a pure tone (not really the same as voice, which fluctuates a lot) of minus eight dB PEAK to equate zero VU.

When recording these two actors, we find that Tough Guy usually moves the meter on our recorder to, say, around minus 6. The Nerd hits around minus 10, which is a bit lower in volume and natural. Again, we reserve levels above minus 6 or so for very loud sounds (which would translate into signals of zero to plus ten on a VU meter).

So as much as possible during this shot, we want to maintain this recording relationship of Tough Guy around minus 6 and Nerd around minus 10. This is especially important to do if we are opening and closing multiple mics.

In addition to the actors, we must also be attentive to background noise. If we are continually adjusting the levels of our mics on the set to balance the levels of our actors, then the side effect is for our background noise to go up and down like a roller coaster.

The way to avoid problems with the background noise is to take advantage of the acoustic properties of the mics we use in order to control the relative levels of the dialogue by means of microphone positioning (distance) and angle rather than by electronically adjusting the gain (volume) at the recorder or mixing panel.

Shotgun microphones are more sensitive in the front ("on axis") and less sensitive from the side ("off axis"). Therefore, in order to balance the levels between Tough Guy and Nerd, the boom operator should hold the mic closer overhead to the Nerd with the front of the mic aimed more towards the Nerd, and allow the Tough Guy to strike the mic from more of a side angle and from a little further away. The increased distance to the mic along with the reduced sensitivity of the off axis angle will effectively reduce the volume of the Tough Guy in relation to the Nerd without affecting the constant level of the background ambiance.

As you can well imagine, the boom operator is a very important player. That is why boom operators need to be chosen carefully by the Mixer and cannot merely be selected from the pool of bystanders who aren't busy in the shot. This is also why it is very important for boom people to be provided with a good headphone feed of the program material.

When it is time to record another take of the same shot, once again it is critical that the Mixer pay attention to the relative levels of the characters and background. Footage from this take may be combined later on with past or future takes, so consistency of sound quality and levels is important.

When the camera changes its angle, the Mixer must be

especially attentive that the levels of the new shot match and be intercuttable with the previous angles. Tough Guy should still be recorded around minus 6, where we established him before. Likewise, Nerd should remain around minus 10, where he was previously established. Remember, the audience should not be cognizant of an edit or camera angle change within the complete mise en scene; the action must appear to flow seamlessly from point A in time to point B in time.

Minor changes in angle do not motivate drastic changes in audio. Panning or cutting from one close-up to another of two people standing around talking does not constitute a significant perspective change. Levels and background are expected to remain constant.

One should be careful not to confuse perspective with volume. In the medium long shot, Tough Guy speaks at minus 6 and Nerd at minus 10. The boom mic is maybe two and a half feet overhead due to the loose framing of the shot. When we push in to a single head close-up of Nerd, the boom mic is able to move in to a much closer position. It becomes relatively easy to record Nerd at minus 6 because the mic is so close. That would be an error!

In real life, when we talk with a person standing ten feet away from us, we tend to both see and hear more of the surroundings. But when we step in closer to the person, our mind tends to blank out some of the surroundings as we focus our eyes on the face in front of us. This is a perspective change. It is also a ***gradual*** *and* ***self-motivated*** *change.*

In cinema, changes in camera angle occur spontaneously and are motivated by the director/editor, not the viewer. The change may be a bit of a sensory shock.

Audiences tend to accept the visual change, since in real life our brain is constantly shifting focus and scope of what we see (a biological imitation of zooms and cuts, if you will). But it takes us longer to adapt to outwardly imposed changes on the audio, especially when it creates a discontinuity of levels (normal, loud, soft, loud, normal, soft, soft, loud, etc.) within the scene.

Getting back to our example scene above, when we move the mic closer to the Nerd for his close-up, the effect is to make his voice dominate over the surrounding background, which is in keeping with the natural change in perspective. But if we allow his voice level to rise above its established level range, then the audio becomes disjointed from the time line of the complete scene and will not smoothly intercut with the rest of the footage.

Therefore, when you move the microphone in for a close-up, re-adjust the volume so that the actor's voice level remains constant with the rest of the sequence. Characters' audio should be somewhat constant throughout the course of the scene, even as the shot changes from wide shots to mediums to singles to reverses to mediums, etc. If you were to close your eyes, the changes in audio from shot to shot should not be unnatural nor unexpected.

This is not to say that if an actor walks distantly away from camera that his voice level should not diminish. Of course it should, as it would in real life. But a variation in camera angle (as opposed to a change in actor location within the set, visual or implied) does not warrant a major change in audio levels. However, a major change in camera LOCATION may justify a change in relative audio, particularly the background.

Of course there are always going to be some changes in audio levels. This is an art form, not a controlled manufacturing process. The nature of production is such that we can't always control things as much as we'd like to, such as mic placement and background ambiance. The idea, though, is to at least try and keep these level changes as minimal and inconspicuous as we can when we record them; and then to fix them completely during post-production.

Not only does sound need to be consistent within a shot, and from shot to shot, since this footage may all be integrated during editing — but sound must also match up when scenes butt up against other scenes.

Throughout the duration of the production, try to establish and then maintain relative audio levels for all of your characters. Change perspective (the blend of background to dialogue) as necessary, but try to keep your characters as constant as possible.

Equalization is another important aspect to consider, as well as straight audio level. Avoid using any more equalization than is absolutely necessary on the set. Traditionally, a mixer will roll off the excess bass frequencies to reduce wind noise and rumble, especially out of doors. Some mixers like to boost the mid-range frequencies just a smidge, in order to emphasize speech over ambiance. High frequencies are usually left alone.

If you choose to employ some equalization on a shoot, make certain than you apply the setting consistently from the first till the last day of production. For instance, many mixers have a set degree of bass rolloff that they will use outdoors and a lesser amount of rolloff for interiors. That is okay since people do sound different outside than inside. But do not vary the intensity of rolloff from day to day based on the local wind conditions. Otherwise, what sounds good Monday and Tuesday may not intercut well with material recorded the week before, or the month later!

Resist the temptation to sweeten the mix on location by playing with all those colored dials. Once you record something with EQ, it cannot be undone later on. Record your tracks as plain as possible, and save the special effects and final tweaking for post, where they have the liberty of working with edited sequences and of repeating their attempts until it all sounds right.

The only time that a mixer is justified to employ extraordinary EQ to improve a shot (that is, anything over and above your "permanent" bass rolloff and possible midrange bump) is when the alternative is to absolutely have to loop the scene unless correction is applied. In other words, you can play with the EQ only when you have absolutely nothing to loose and anything to gain. If in doubt, leave the EQ settings alone!

EQ is justified, though, to match plant mics and lavaliers to the "non-equlaized" or natural sound of the main boom mic. In this case, we are using the EQ to maintain consistency of tone with our primary mic and primary dialogue.

In conclusion, plan ahead! See how your characters interplay, and then try to establish and maintain their relative audio levels and EQ regardless of close-up or wider shot. Changing perspective does not mean changing volume, only reducing background. Louder does not mean better. Adjust your EQ "permanent" settings for interior or exterior, but do not mess around from shot to shot nor scene to scene.

Above all else, think like an editor. All this stuff has to intercut smoothly and seamlessly. From consistent work habits you will achieve consistent soundtracks.

Recording Production Audio for DV, Hi8mm, etc.

Small format video (DV, Hi8mm, SVHS) is being used ever increasingly for professional application. The various merits of shooting images with these relatively inexpensive, inobtrusive, and extremely portable video acquisition systems are familiar to most readers. However, interfacing these consumer and pro-sumer camcorders with professional audio can be a nightmare.

Use the consumer shotgun mic that comes with the camera (or is sold as as aftermarket accessory) and everything sounds fine. But try to plug in your thousand dollar professional microphone and the result is a lot of buzz, humm, and lower audio levels.

Let's examine why this happens and how to fix it.

Most camcorders will readily accept the industry standard 250 ohm low-impedance microphone input signal, so the problem is not that of matching impedance level so much as it is a question of proper input cables. Purchasing an impedance matching device is not the solution to your problem.

The mic input is generally a 3.5mm mini stereo jack. The output of a professional grade microphone is XLR 3-pin. Therefore, the first task at hand is to adapt XLR 3-pin output to mini stereo input. To do that, we need an adapter cable that consists of a female XLR 3-pin connector at one end feeding a mini stereo plug at the other.

Since the camcorder input is stereo, our adapter cable needs to split the incoming monaural audio over both the left and right camcorder channels. If we were to record onto only one channel, we risk serious damage to our soundtrack.

The second, empty, channel would fill with hiss and noise. When our audio is transferred from analog video (Hi8mm) for post-production, a percentage of this noise will most likely bleed into the good channel. Such is the nature of Hi8mm audio, due to the proximity of the recording tracks and head placement. Some digital also suffers from track bleed, though not as much. It depends on the camera.

In addition to audio bleed, the presence of an empty track may cause confusion or even havoc with the automatic gain control in the camcorder. Even those cameras that offer a manual audio level control will revert to auto gain if the power is turned off, tape changed, or battery changed. Unless you are meticulous, the resumption of videotaping may be with auto gain ON.

Finally, recording to just one camcorder channel makes it difficult to monitor some meter levels and to hear with both sides of the headphones (unless you use cumbersome adapters with your headphones).

Bottom line: Always feed the Left and Right camcorder channels, either with monaural audio going to both sides, or with discreet stereo audio going onto respective Left and Right. Never assume that what is on the second channel will not show up in some form on your first channel, so be very careful if recording wild questions or cue tracks that you plan on editing out.

What about the buzz?

Earlier in this article we mentioned those aftermarket micropones that the consumer manufacturers would so dearly like us to invest in. Most of those mics are of the electret condenser design, meaning that they need to see a few volts of DC power in order to function.

To power these mics, the camcorders produce three to six volts DC at the mic input jack. Even those camcorders that have a separate DC OUT micro jack alongside of the MIC INPUT jack, still root the DC circuit in the ground of the MIC jack. Unless your plug-in mic is of the precise electronic formula of the camera maker, you may experience symptoms of DC interference.

Depending on the particular characteristics of your pro mic, these DC related symptoms may be: non-existant; a loss of gain/volume; buzz/humm; or even intermittantly increasing buzz/humm. Different types of mics react differently.

To eliminate this buzz problem, the upstream DC voltage must be blocked by means of capacitors. Choose your capacitors wisely, for too little will not cure the buzz, and too much will affect the mic signal.

If you are wondering if anyone manufactures an adapter cable that remedies all of these problems, then stop your wondering. Equipment Emporium in Misson Hills, California designed their XLRH8 Audio Adapter Cable a few years ago to solve the

audio problems that many law enforcement agencies were encountering with the use of their Canon LX100's and Sony's. Today's XLR-H8/DV cable is an improved version of those cables intended for DV as well as Hi8mm/SVHS.

The basic XLR-DV cable is a short adapter that features one female XLR 3-pin connector at one end and a mini stereo plug at the other. Audio is split over the left and right camcorder channels. Blocking capacitors housed inside of the shell of the XLR knock out the DC interference.

Equipment Emporium recommends slipping a rubber band around the mini connector and pulling it around the camera body like an oxygen mask, thus applying inward tension on the connector. The XLR connector of the cable should be strain relieved by tying or taping it to something sturdy on the camera body, such as the strap lug.

Never allow any long cables or any weight to tug directly on the mini jack of the camcorder; the jack is fragile and can loosen or damage easily.

Other versions of the XLR-DV cable are available in a discreet stereo model that features two XLR inputs; and a model that will attenuate a line level stereo XLR input to mic level mini stereo output.

Equipment Emporium also sells the BeachTek XLR box that fastens underneath most camcorders and provides two XLR mic/line inputs. Output is a stereo mini plug that connects to the mic input jack of the camcorder. Price is approx $199.

We also sell the SV Ltd's model XLR-PRO, which is also an adaper box that mounts beneath the camera body. It also features two XLR inputs for mic/line, mono/ stereo, and volume controls. Price is only $159.

Studio One makes the XLR-BP-PRO, which is a beltpak adapter box featuring two XLR inputs, switchable for mic/line, volume controls (attenuation), mono/stereo, ground lift, as well as 1/4-inch and 1/8-inch inputs (which you should be cautious about using). The box features DC blocking and almost no internal loss of mic signal (unlike certain other brands). It is less expensive than the original XLR-PRO boxes.

Being a belt-pack has advantages and disadvantages (you be the judge).

Disadvantage is that it does not mount underneath the camcorder, so there is one more item to deal with when you pick up or put down the camera. Be VERY careful not to tug on the stereo mini connection to your camera (strain relief it!).

Advantages include the fact that the box does not mount underneath the camcorder. Easier access to changing tape, and more secure mounting to tripods and shoulder mounts. Any major tugging from the mic cables is absorbed by your hips, rather than causing the camera to suddenly lurch while videotaping.

Overall, we are extremely pleased with this new design. Introductory price is only $199.00

Studio One also makes a a beltpak adapter that only offers mic level input (the XLR-BP) and sells for only $129. But sooner or later, you will kick yourself for not having line level capability!

A special note. Some of the new digital camcorders are fairly forgiving of external audio and do not require the special XLR-DV cables. All that they need is just an adapter cable that converts from XLR female to stereo mini. However, be warned, that some of the off-the-shelf adapter cables are wired incorrectly. They are set up for a stereo mic (XLR) going to stereo mini. Pin 2 of the mic goes to tip (left) and pin 3 of the mic goes to ring (right). If you plug a monaural mic into that cable, the sound will be

recorded out of phase on left and right, which means that when you go to transfer the audio will be low volume or not audible. A correctly wired adapter cable will have pin 2 from the mic connected to both the tip and ring; pins 3 and 1 from the mic both go to the sleeve of the mini connector. Equipment Emporium does sell the properly wired adapter cables, as well. ($18)

Which brings us to the next topic in our Audio for DV discussion: line level feeds.

Audio coming from a mixing board is usually at 600 ohm line level, which is a much hotter and stronger signal than mic level. However, most camcorders only accept mic level external input when used as a live camcorder; when the camcorder is used as a VTR it will accept external line level video and external line level audio via the RCA jacks in the back. When the camcorder is functioning as a camcorder, the RCA inputs are disabled.

Therefore, to feed line level audio into a camcorder (which is mic level), we need to reduce the signal by 30 to 50 dB.

Some mixing boards, such as the Shure FP's and the newer Mackies, have a switch to reduce their outputs from line to mic level. You can't ask for more convenience than that!

Otherwise, one needs to insert a pad or attenuator between the output of the mixing board and the input of the camcorder. Shure makes a 50 dB line to mic Attenuator. Audio Technica offers a switchable -10, -20, -30dB pad. Either of these devices will work, since the camcorder input does have some range with its gain or volume.

Sometimes when you feed from a mixing board, the DC interference at the mic input jack may be a problem. Sometimes it may not. It all depends on the design of the mix board.

To play it safe, use an input cable with DC blocking, such as the XLR-DVcables.

So far, we have only discussed the logistics of getting an audio signal into the camcorder. Now, a few comments on what that signal should be.

There is an old computer programmers expression that goes "garbage in, garbage out." That applies to production sound, as well. It does no good to have a clean signal entering the camcorder if that signal is worthless to begin with!

Just because you are recording on an inexpensive medium is no excuse to be lazy with technique. Small camera or not, a tripod and lights will still make the difference between a home movie and a professional product. And proper microphone deployment and mixing are still esential if you want a professional sounding track.

Use the same mics and techniques that you would on a big budget show.

Mic your subjects from close overhead with a boompole, and use high quality ENG or full condenser shotgun mics.

If using lavaliers or wireless mics, pay careful attention to proper placement and rigging. Check for clothing and wind noise.

Adjust any cables that function as antennas. If possible, mount your receiver as close to the action as possible, any pay careful attention to antenna line of sight.

Mounting a radio receiver on a consumer camcorder can be tricky, since these cameras are not as well shielded as their professional large format counterparts. Camcorders tend to produce a lot of RF interference near their viewfinders and near the recording heads. Try moving the receiver around to find a "sweet spot" that is free of buzz or humm.

If your camcorder is equipped with an auto gain control, then your best strategy for eliminating or reducing the "hunt for some sort of noise to amplify" is to make sure that you feed a well mixed or well chosen signal to the camera.

Think of it in terms of working with a still camera that has auto light metering. Frame up on a high contrast or unusual lighting condition and you get horrible exposures. But compose a scene with some highlights, shadows, and a lot of middle tones and the exposure comes out beautiful.

It's the same way with sound. Feed your camcorder a strong signal with dialogue dominating over ambience; or sound effects dominating over background noise -- and the resultant soundtrack will be fine.

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XL1 Audio Step-by-Step

Introduction

One of the many advantages of the new DV format is found in it's greatly expanded audio capabilities. The Digital Video standard includes Pulse Code Modulation (PCM) audio recording. In conventional analog recording, sound waves are recorded as changes in the magnetic field on the tape. In digital audio recording, sound is recorded as 0 and 1 after it is converted in pulse codes. This is the reason digital audio is referred to as Pulse Code Modulation. The digital audio code (a series of "off or on" signals) is recorded by the drum, on a part of the tape that is separate from the video information. A provision for PCM is part of the 8mm video specifications, however, Canon has not used this optional sound track in any of its 8mm or Hi8 models to date.Sound waves are vibrations in the air with two basic properties: the first is frequency, from low (bass) to high (treble); the second is amplitude, from soft to loud. Together they form a simple sine wave. The wave's amplitude is represented by its height; the further the curve swings above and below its center line, the louder the signal. Its frequency can be represented by the number of times per second the wave goes through a complete "cycle". The more cycles per second, the higher the wave's frequency. The average young human ear can hear frequencies from about 20 cycles per second (20 hertz, or 20 Hz), a very low base tone, to about 20,000 cycles per second. The distance between peaks is the wavelength, which becomes shorter as the frequency rises.Analog Signal Digital Signal

The camcorder's microphone picks up sound and outputs an analog signal consisting of minute voltage changes. This signal is then passed through an analog-to-digital (A/D) converter. In a digital recording, the original sound wave is measured at thousands of sampling points per second, and records those voltage samples as numbers. In playback, the sampling points are recreated, and the audio is processed by a digital-to-analog converter (D/A).The quality of the reproduction depends on how detailed the blueprint is, and how well the reconstruction is done at the playback end. The amount of detail mainly depends on the number of samples per second (which controls frequency response) and the number of binary digits, or "bits" per sample (which controls noise and distortion).

Most sound waves are complex mixtures of simple sine waves. We only need to record two points per cycle of such a wave's highest frequency to be able to reconstruct the wave in playback. The sampling frequency (the number of times the signal is measured per second) must be high enough to ensure at least two samples for every wave of every audio frequency—at least 40,000 samples per second for an audio band going up to 20,000 Hz.Digital systems measure in steps, but the analog signals they're measuring are continuous. An analog signal that ranges between +1 and -1 volts goes through an infinite range of values between those points, but a digital system can record only a finite number of those values. The more digits it has, the more steps it can distinguish and the more closely it can match its readings to the variations in the original signal. Because digital systems use finite means to record infinite signal variations, some mismatch is inevitable, and every such mismatch adds noise and distortion to the signal.Digital systems use the same binary numbering systems found in computers; that is, each digit only has two possible values, 0 or 1. Each digit added doubles the number of possible values the system can handle: a one-digit number has two values (0 and 1); a two digit number has four values (00, 01 10, and 11; a three-digit number has eight possible values; and so on.

Every time a digit is added to a digital recording system, the amount of its inaccuracy—and, therefore, its noise and distortion—is cut in half. This increase in accuracy is equivalent to cutting noise and distortion

by 6 dB; so you can roughly gauge a digital system's dynamic range by multiplying its digits, or bits, by six. For example, a fourteen-bit system has 84dB of dynamic range, and a sixteen bit system (such as the compact Disc) has 96 dB.The number of bits in a system, limits the dynamic range. Slight signal overloads don't cause slight increases in distortion, as they do in analog. In digital systems, they cause sudden, intolerable distortion. Weak signals, no stronger than the system's noise, are simply not recorded at all. Even though the digital system's dynamic range is firmly limited, its limits are far wider than those of most analog systems. At 96 dB, those limits are wide enough to accommodate the entire dynamic range of music.When you copy a signal, you degrade it. In analog, this limits frequency response and adds noise and distortion. There is no degradation in digital reproduction.

Digital has another virtue—no wow or flutter. The tiny speed variations that cause wow and flutter in analog tape recorders are also present in digital ones, but you never hear them. As samples are read off the recording, they're fed into a buffer circuit, which smooths out the speed variations.The XL1 offers three digital audio modes:

The device responsible for changing an analog signal into a series of numbers is the analog-to-digital converter. It measures (or "samples") the strength of the changing voltage at regular intervals, generating a steady stream of numbers. Two parameters directly affect the quality of the resulting audio: sample rate and bit depth. The converter's sample rate dictates how often it measures the signal to generate a new value. The more frequently the converter measures the signal the more accurate the resulting data. Sample rate corresponds directly to frequency response—the highest frequency a digital system will capture is exactly one-half the sample rate. To capture the full audio spectrum up to around 20,000 cycles (or 20kHz), a sample rate of 44.1kHz is common. Higher sample rates make for increased treble response and a more "hi-fi" sound. Low sample rates sound duller and darker.Bit depth affects how many bits the converter uses for each numerical measurement of the signal. More bits equal a more accurate measurement, which explains why 16-bit CD audio sounds so much better than an 8-bit multimedia sound file. A low bit depth allows the converter the measure the sound with a yardstick marked only in inches. A higher bit depth allows the converter much greater accuracy (a yardstick marked in 1/8th inch increments, for example).

16 bit (48kHz, 2 channel) for the highest sound quality. "16-bit" refers to the amount of data recorded and the range of the data (16-bit converted to decimal numbers means that there are 65,536 different numbers that can represent any sample). 16-bit represents the most data for the truest and fullest range of sound. DV specifications call for a sampling rate of 48 KHz (48 thousand times per second), 44.1 KHz or 32 KHz. (DAT uses 48KHz sampling and CDs use 44.1 KHz sampling).

12 bit stereo (32kHz, 2 channels) records on two of the four available channels (Stereo 1), leaving two other channels (Stereo 2) available for the addition of sound, music, narration, etc. 16 bit sound produces CD quality, two channel sound on one track. The 12 bit mode divides the audio track into two, recording two channels on one track while leaving the remaining track open for post production audio recording with separate editing gear. In other words, you can add new sound later using a DV VCR. You cannot add new sound to a tape using the XL1.

12-bit stereo (32kHz, 4 channels) for simultaneous recording on four channels (Stereo 1 and Stereo 2). Audio can then be output as 4 independent channels.

With 12-bit, the sound quality is just slightly lower, because the amount of data gathered through the sampling and quantization procedures is lower than with 16-bit (4,096 variations for 12-bit compared to 65,536 for 16-bit). The 12 bit sound is sampled at 32 KHz. Because there is less data, it does not take up all the space available to audio on the tape, resulting in 2 two-channel tracks.

With 12-bit audio, you can use the microphone mounted on the camcorder plus up to two remote microphones, all recording on separate channels, at the same time. At the editing stage, selections can be made for the desired mix for the finished video. Or, if only two channels are used, the original audio can be

left on the tape while new audio (music and narration, for example) can be added without erasing the original sound during the editing process.

XLR Microphones

Unbalanced audio equipment is generally found on consumer camcorders, and indeed all previous Canon camcorder models have used a 3.5mm mini-jack as their input. An unbalanced microphone may work well attached to the camera, however if it's range is extended, the microphone cable frequently picks up interference from extraneous electro-magnetic fields resulting in hum.Attaching the MA-100 allows the use of two professional XLR microphones, or two wireless microphone receivers on the XL1. Balanced XLR microphones contain a noise-canceling cable that greatly reduces unwanted interference. The MA-100 converts balanced signals from the XLR microphones to unbalanced signals. The MA-100 includes RCA plugs which can be connected directly to the camcorders RCA audio terminals.

Locked and Unlocked Audio

The XL1 records sound in "unlocked" audio. Unlocked audio does not mean out of sync audio. Unlocked audio is always completely in sync with the video. The difference has to do with the number of audio samples per video frame. With locked audio the sample rate per frame of video is fixed, while unlocked audio allows for some slight variations in the number of samples per frame.

Terminals vs. Tracks

The XL1's 3.5mm Mini Jack is used for the supplied microphone. Audio 1 and Audio 2 refer to the physical location of the audio inputs. The Audio 1 terminals appear on the back of the camcorder, the Audio 2 terminals are on the handle. Stereo 1 and Stereo 2 refer to the stereo tracks available on the tape.

AUDIO INPUT FOR TWO CHANNEL RECORDING (Stereo 1) USING THE MINI JACKS

SOUND SOURCE: supplied microphone or external microphone plugged into the mini jacks (3.5mm mini-plug type).

Open the Camera Menu and select AUDIO MODE.
Choose one of the following modes:
16-bit (48KHz, 2 channel (for the highest sound quality)
(Note: 16-bit mode only contains Stereo 1 sound)
12-bit Stereo 1 (32kHz, 2 from 4 channels) for recording on 2 channels (Stereo 1), leaving 2 channels (Stereo 2) free for you to add new sound at a later date using a DV VCR. NOTE: you cannot add new sound to a tape using the XL1 camcorder.
Close the menu. The name of your chosen mode is displayed in the viewfinder and main LCD panel. It is unnecessary to set AUDIO 1 to MIC on the menu.
Slide the INPUT SELECT switch to MIC.
This assigns the MIC mini jacks as the source for the audio input. You can use the supplied microphone or attach an external microphone.
or
Slide the INPUT SELECT switch to ATT.
If you are recording in a very loud environment, (at an airport for example) you may want to use the attenuator. The attenuator reduces loud noises to

produce a more natural sound.

Select the recording level method.

Normally, the camera sets the audio recording level automatically, as long as the REC LEVEL switch is set to A. You can set the recording level manually:
Slide the REC LEVEL switch of the AUDIO 1/Mic controls to M. (MANU appears in the audio LCD panel).
Turn the LEVEL dial to adjust the recording level and BALANCE dial to adjust the balance between the 2 inputs. Check the levels in the audio LCD panel. Note: you can not adjust the volume level independently for the left and right channels. We recommend keeping the level below the 12 point index mark, and monitoring the sound using headphones. You can adjust the headphone volume by rotating the PHONES LEVEL dial.

AUDIO 1 INPUT FOR TWO CHANNEL RECORDING (Stereo 1) USING RCA JACKS

SOUND SOURCE: VCR, CD or other input device using the RCA terminals on the back of the XL1, instead of the mini jack.
Open the Camera Menu and select AUDIO MODE.
Choose one of the following modes:
16-bit (48KHz, 2 channel (for the highest sound quality)
(Note: 16-bit mode only contains Stereo 1 sound)
12-bit Stereo 1 (32kHz, 2 from 4 channels) for recording on 2 channels (Stereo 1), leaving 2 channels (Stereo 2) free for you to add new sound at a later date using a DV VCR. NOTE: you cannot add new sound to a tape using the XL1 camcorder.
Close the menu. The name of your chosen mode is displayed in the viewfinder and main LCD panel.
Slide the INPUT SELECT switch to AUDIO 1. This assigns the AUDIO 1 RCA jacks as the source for the audio input.
3. Open the Camera Menu and select AUDIO 1 INPUT. Then choose:
LINE: to record sound from a VCR, CD or other line in devices
4. Select the recording level method.
Normally, the camera sets the audio recording level automatically, as long as the REC LEVEL switch is set to A. You can set the recording level manually:
Slide the REC LEVEL switch of the AUDIO 1/Mic controls to M. (MANU appears in the audio LCD panel).
Turn the LEVEL dial to adjust the recording level and BALANCE dial to adjust the balance between the 2 inputs. Check the levels in the audio LCD panel. Note: you can not adjust the volume level independently for the left and right channels. We recommend keeping the level below the 12 point index mark, and monitoring the sound using headphones. You can adjust the headphone volume by rotating the PHONES LEVEL dial.

AUDIO 1 INPUT FOR TWO CHANNEL RECORDING (Stereo 1) USING RCA JACKS

SOUND SOURCE: XLR type microphones

XLR microphones are attached via the MA-100 Microphone Adapter/Shoulder Pad which contains 2 XLR inputs (L and R). The MA-100 can be plugged into the AUDIO 1 RCA terminals on the back of the camcorder, or AUDIO 2 RCA terminals on the handle.

Open the Camera Menu and select AUDIO MODE, then choose:
16-bit (48KHz, 2 channel (for the highest sound quality)
(Note: 16-bit mode only contains Stereo 1 sound)
12-bit Stereo 1 (32kHz, 2 from 4 channels) for recording on 2 channels
(Stereo 1), leaving 2 channels (Stereo 2) free for you to add new
sound at a later date using a DV VCR. NOTE: you cannot add
new sound to a tape using the XL1 camcorder.
Close the menu. The chosen mode is displayed in the finder and main LCD.

If you are using the AUDIO 1 inputs, slide the INPUT SELECT switch to AUDIO 1. This assigns the AUDIO 1 RCA jacks, on the back of the XL1, as the source for the audio input and disables the supplied microphone.

3. Open the Camera Menu and select AUDIO 1 INPUT, then choose:
MIC ATT 20: recording sound using a mic, when the sound level is high
MIC: to record sound using a XLR microphone
Select the recording level method. Normally, the camera sets the audio
recording level automatically, as long as the REC LEVEL switch is set to A.
You can set the recording level manually:
Slide the REC LEVEL switch of the AUDIO 1/Mic controls to M. (MANU
appears in the audio LCD panel).
Turn the LEVEL dial to adjust the recording level and BALANCE dial to
adjust the balance between the 2 inputs. Check the levels in the audio
LCD panel. Note: you can not adjust he volume level independently for
the left and right channels. We recommend keeping the level below the
12 point index mark, and monitoring the sound using headphones. You
can adjust the headphone volume by rotating the PHONES LEVEL dial.1

AUDIO INPUT FOR FOUR CHANNEL RECORDING (Stereo 1 and Stereo 2)

(Simultaneous recording of all Four Channels)

SOUND SOURCE: Supplied microphone, external microphone, VCR, CD or other line in devices, or using XLR type microphones

Four channel recording can be the most versatile configuration. For example, you can input two external wireless microphones and use the supplied microphone all simultaneously.

Open the Camera Menu and select AUDIO MODE.
Select "12 bit ST-1, 2", and close the menu.
"12bit ST-1,2" is displayed in the viewfinder and main LCD panel.
Selecting Audio Mode 12 bit ST-1,2 (32kHz, 4 channels) is for simultaneous
recording on four channels (Stereo 1 and Stereo 2)

To set the input for Stereo 1:

Use the supplied mic or external microphone plugged into the mini jacks
Slide the INPUT SELECT switch to MIC.

This assigns the MIC mini jacks as the source for the audio input. In place of thesupplied microphone, you can attach an external microphone to the mini jacks.

or

Slide the INPUT SELECT switch to ATT.

If you are recording in a very loud environment, you may want to use the attenuator.The attenuator reduces loud noises to produce a more natural sound.

orUse the Audio 1 RCA jacks on the back of the camcorder to record sound from a VCR, CD or other line in device or XLR microphones.

Switch the Input Selector to Audio 1. Open the Camera Menu and select the appropriate option for AUDIO 1 IN:

LINE: To record sound from a VCR, CD or other line in devicesMIC ATT20: to record sound using a microphone, when the sound level is high.MIC: To record sound using a XLR microphone attached to the MA-100 MicrophoneAdapter/Shoulder Pad.

To set the input for Stereo 2.

Connect a device to the AUDIO 2 RCA jacks on the handle. From the Camera Menu, select Audio 2 INPUT, then select the appropriate option for AUDIO 2 IN:

LINE: To record sound from a VCR, CD or other line in device

MIC ATT20: To record sound using a microphone, when the sound level is high.

MIC: To record sound using a XLR microphone attached to the MA-100 Microphone Adapter/Shoulder Pad.

4. Select the recording level for 4 channel recording

Normally, the camera sets the audio recording level automatically, as long as the REC LEVEL switch is set to A. You can set the recording level manually:

Set the recording level for stereo 1:

Slide the REC LEVEL switch of the AUDIO 1/MIC controls to M.

Turn the LEVEL dial to adjust the recording level and BALANCE dial to adjust the balance between the two inputs. Check the levels in the audio LCD panel. Note: you can not adjust the volume level independently for the left and right channels. We recommend keeping the level below the 12 point index mark, and monitoring the sound using headphones. You can adjust the headphone volume by rotating the PHONES LEVEL dial.

b. Set the recording level for stereo 2:

Slide the REC LEVEL switch of the AUDIO 2 controls to M (manual).

Turn the L and R dials to independently adjust the recording levels of the two inputs (corresponding to the L and R channels of the Audio 2 RCA jacks). Check the levels for each channel in the audio LCD panel. It is essential for you to monitor the sound using headphones. Adjust the headphone volume by rotating the PHONES LEVEL dial.

Audio Monitor

Using the Audio Monitor selector is only effective when using 12 bit (Stereo 1 and Stereo 2) mode, since this is the only mode which would have a selection. If you are recording using 16 bit mode or 12 bit (ST1), then the sound is fixed in Stereo 1 only.

Camera Recording

Located just below the audio meter, on the left side of the camera, the audio monitor button allows you to select the sound source you want to record:

stereo 1, stereo 2 or a mix of both. Use headphones to monitor the audio while recording. Press the AUDIO MONITOR button to make a sound check. With each press you can cycle through … ST 1 (Stereo 1 only)

ST 2 (Stereo 2 only)

MIX (Mixture of ST 1 & ST 2 at a ratio of 1:1 is always used in Camera mode)

Your choice is selected a few seconds after you last pressed the button, and shown in the viewfinder and audio LCD panel.

Selecting the Audio Output in VCR Playback Mode

During playback, the XL1 only plays the audio you have selected with Audio Monitor! When playing back a tape in which the audio was recorded in 12 bit (Stereo 1, Stereo 2) mode, you can select the output you would like to listen to. Press the AUDIO MONITOR button to cycle through the selection:

Stereo 1, Stereo 2, or a MIX (1:1) or VariableWhen you have chosen the output, STEREO 1, STEREO 2 or MIX will be shown in the top left of the viewfinder and in the audio LCD panel. If you turn the power off, the output (and display) defaults to STEREO 1.

If the sound was recorded in 16 bit mode, it only contains stereo 1 sound and you can not select the audio mix. You also can not select the audio mix if 12 bit stereo 1 mode was used, unless new sound has been added with a DV VCR.

If you select MIX Selection (1:1) a mixing ratio of Stereo 1 to Stereo 2 is 1:1.

If you select MIX Selection .. Variable, a mixing ratio of Stereo 1 to Stereo 2 can be adjusted. For this adjustment, you can use the + (up) and - (down) cursor keys to choose the mix balance (or the ST-1/St-2 MIX BALANCE buttons on the remote control. There are 10 steps displayed on the screen. The center position indicates a mixing ratio of 1:1.

Choosing the Output Channel

Make sure the camera is set to VCR mode. Open the menu and select the output channel you wish:

L/R (Stereo) is the default setting

In the normal stereo mode, the left-side signal is output at the left channel terminal and the right-side signal is output at the right channel terminal.

If the audio mode is 16 bit or 12 bit Stereo 1, the audio signal will be sent to the RCA jacks labeled L and R.

If you chose Stereo 1 for the output at stage A, Stereo 1 (L&R) will be sent to the RCA jacks labeled Audio 1 (L&R). In addition, stereo 2 (L&R) will be sent to the RCA jacks labeled Audio 2 (L&R). This gives you four independent audio signals.

If you mixed the balance at stage A, the combination of left channels from stereo 1 and stereo 2 will be sent to the left channel of Audio 1 and the combination of the right channels will be sent to the right channel of Audio 1.

L/L Only the left-side signal is output to the RCA left and right jacks. For reproducing only main voice of bilingual information recorded on other equipment.

R/R Only the right-side signal is output to the RCA left and right jacks. For reproducing only sub voice of bilingual information recorded on other equipment.

L + R/R Gives a mono output. Sound from the left and right channels are combined and sent to the left RCA jack.

Introduction to Timecode Recording

Over the past several years, it has become ever increasingly common to record production tracks with a SMPTE timecode reference instead of the traditional 60 Hz sync pulse. This article is intended as an introduction and overview of the use of SMPTE timecode in conjunction with Nagra analog recorders and DAT.

Types of Timecode

Non-Drop vs Drop

The original timecode system is known as non-drop frame, since it assigns a progressive number to every video frame (0-29). This is an accurate way of tracking individual frames, but caused a problem for video editors when they compared elapsed "real time" to "videotape time". Due to the fact that video actually runs at 29.97 frames per second and NOT 30 frames, editors discovered that they could be off by 3.6 seconds at the end of a one hour show.

In order to "synchronize" the clocks on the wall with the elapsed time counters in the edit system, video engineers developed drop-frame timecode, which works sorts of like a leap year in reverse. Two frame numbers are dropped or skipped every minute, except when the number of the minute ends in zero, such as minutes 00, 10, 20, 30, etc. It is important to realize that the video frames themselves are not deleted. Only their numerical labels are affected.

Frame rates

The correct timecode frame rate for video is 29.97 fps. Other rate options for film include 30, 24, and 25 fps.

So which frame rate and mode to use?

If you are recording for a video shoot, then use whatever mode (drop or non-drop) that the videotape recorder is using. Usually, video prefers to use the drop-frame mode, for the reasons discussed above. But always check with the engineer or camera operator just to be sure.

Video records at 29.97 fps, so that would be the correct timecode speed for your audio recorder.

If you are recording audio for a film shoot, the settings are different.

Film editors generally (but not always) prefer to use non-drop timecode for keeping track of frames, since it eliminates confusion when converting from edited video back to film. So unless otherwise instructed, use non-drop timecode on film shoots.

The correct frame rate for recording audio that will be sync'd to film is 30 fps, irregardless of whether the film camera is running at 24fps or 30fps! The reason for this is that the audio does not have to correspond to the film speed but rather to the video speed, since the editing is being done in video!

When the film is transferred to video (for editing), it is slowed down by one tenth of one percent. Film shot at 24fps ends up at the equivalent film speed of 23.97 on the video monitor. Film shot at 30fps film sped ends up at 29.97 film speed in video.

For audio to remain in sync, it must be slowed down by the same percentage. So if we record audio on the set at 30fps timecode, and then transfer it into the edit system at 29.97 fps (which also happens to be video sync) — the audio will end up in perfect sync with the picture.

When the editing is completed, the audio will be speeded up from 29.97 to 30 in order to match back up with the actual film for creating release prints. But that is not your concern as a Production Mixer. The post production people and the film labs deal with that issue.

Therefore, unless instructed otherwise, the industry standard for production sound (film shoot) is 30fps Non-drop.

If anyone tells you to use a different setting, make sure that you get it in writing and witnessed! That way you cannot be held accountable for problems that may be encountered by the production company later on.

Running Modes

There are five different running modes for generating timecode. The most basic setting is Free Run / Time of Day. That means that the internal timecode generator is like a clock, denoting the actual time of day. The clock runs continuously, whether the tape is recording or not. This is convenient setting to use, since anyone who needs to note the timecode numbers only has to gaze at his or her own wristwatch. Timecode errors between the slate and the recorders are obvious and easy to detect.

(It is interesting to note that some studios and producers object to time of day timecode because it is a permanent record substantiating overtime claims by the crew.)

The next most common setting is Free Run / User Set. This is similar to the above setting, except that the starting time for the TC generator is chosen by the user and does not correlate to actual time of day. Commonly, the Hours digits are used to signify sound roll number. Spare wristwatches can be reset to match the timecode generator, if you have people on the set who need to keep track of the code.

Record Run timecode means that the generator stops when the tape does. Numbers increment during the Record mode, but remain frozen in time during pause or stop. The elapsed timecode is sort of like a tape counter, and is an

indication of how many minutes have been recorded. Users often use the Hours digits to indicate reel number, rather than an "hour" of the day.

The last two "modes" are External and Jam-Sync.

External refers to continuously reading timecode from an External source and re-generating it onto the tape. If the External code should stop or be intermittant, the code being recorded would also be in error. (Many recorders are programmed with a self-protection that would automatically jam-sync to the last good code and begin generating new code in the absense of the External code.)

Jam-Sync (a.k.a. Set from External) means that the recorder synchronizes its internal timecode generator to match the starting numbers from an External source. When the connection to External is released, the internal code will keep in step with the external timecode source for a few hours or longer, depending on the accuracy of the timecode generators in question (recorder and source). Of course, Jam-Sync only makes sense in the Free-Run timecode modes.

Timecode Slating

There's not much point in recording timecode onto the audio if there is no timecode reference on the picture.

In the case of video, timecode is normally recorded onto the videotape even if audio is recorded separately. Jam-sync all of the timecodes, and that will take care of basic sync (video word sync is another matter, but engineers take care of that on the big shoots). In addition to jam-sync, use either a traditional or timecode clapstick just for protection.

If there is no timecode being recorded onto the video (i.e. prosumer camcorders), then you should use a timecode slate so that the editor can line up the picture with the audio.

When shooting in film, a timecode slate should be used for matching up picture with audio.

The standard of the industry is the timecode slate manufactured by Denecke, Inc. Older versions of these slates were "dumb" slates and could only display the timecode being fed into them via a cable. Early on, mixers began using Comtek transmitters and receivers (similar to a radio mic) to send the timecode from the recorder to the slate, thus eliminating the awkward cable.

Soon after, Mike Denecke came out with his portable sync box, which was a timecode generator that could be attached to the back of the slate. The addition of a self-contained timecode generator makes a slate into a "smart slate".

The sync box could be easily jam-sync'd to the recorder, and could hold sync for half a day. Of course, since re-jamming the timecode is so simple, mixers seldom wait that long.

The latest version of the Denecke slate has a sync box built-in.

Obviously, when you are jam-syncing a smart slate to the recorder, you must use a form of Free-Run timecode, since the slate would have no way of knowing when you are in Record or Pause.

When doing sync playback, as in a music video, the timecode slate needs to display the code of the soundtrack being played back. Therefore, the slate must function as a dumb slate and receive a timecode feed from the recorder (playback source). This feed could come via a connecting cable (awkward!!!) or from a Comtek transmitter system (which is how it is normally done).

Timecode and Sampling Rates

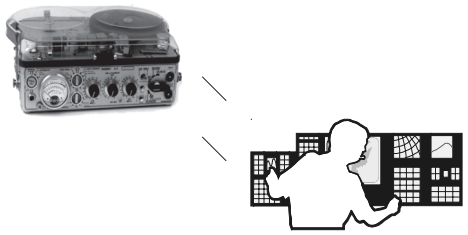
The Nagra IV-STC stereo timecode recorder is an analog reel to reel machine. The tape runs at 7 1/2 inches per second while a timecode track is recorded down the center of the tape. During sync playback, a device known as a sync stripper isolates a sync pulse from out of the timecode signal and sends that signal to the resolver unit, which controls the precise speed of the tape by comparing that signal to a reference signal. Changing the setting (rate) of the timecode will cause a change in the playback speed. For instance, a tape recorded at 30 fps in the field can be resolved at 29.97 fps to slow it down in order to sync with a film-to-video transfer.

But digital recorders work differently. Audio is sampled at a precise speed of 48,000 times per second. Audio is then played back at 48,000 times per second. To change the speed of the audio is not the simple matter of turning the tape reels slightly faster or slower, as in the case of the Nagra. Instead, complex electronic circuitry must be capable of re-sampling the digital audio at a different rate, a task much more complicated than it sounds.

Timecode recorded in digital tends to be cosmetic in nature, and is not used to control the sampling rate of the machine. It is possible in digital to even change the output timecode of a pre-recorded tape without changing the speed nor the original timecode of that tape!

In order to change both the playback speed of the tape as well as the timecode, two tasks must occur. The recorder must alter the sampling rate, and a new timecode must be generated, based on the sub-code of the tape. Merely re-setting the sampling rate (on those machines capable) or re-setting the timecode by itself may not achieve both tasks. Each problem needs to be adressed individually in the machine set-up.

Final Caution: Timecode recording is simple in theory, but can get tricky in practice. Don't take on a gig on your own without being checked out by an expert on the specific hardware package you are planning to use.



Is timecode audio always necessary?

There is a trend in our industry for clients and producers to clamor for the newest and latest technology, regardless of whether or not that technology will really improve the end product.

For example, all of us here at Equipment Emporium recall with great amusement the enthusiasm that a particular music video producer exhibited over using a DAT recorder for sync playback. “This is going to be stupendous! Imagine, we’re going to shoot our video with digital playback! It’s going to be hot!”

Well, of course we had to contain ourselves from laughter. Since the playback track is only a guide track, and does not ever appear in the finished product, it makes absolutely no musical difference whether one plays back from a standard Nagra, a DAT, or any other sync device. The sound being played back is only so that talent has something to hear on the set.

But this producer was not looking at the technical process of making a music video. Instead, buzz words and appearing trendy was at the forefront of his mind.

Case in point, recording SMPTE timecode on the audio track for shows that will be edited non-linear.

Having SMPTE timecode on the audio track that will match timecode on the picture is nice, but far from absolutely necessary. Considering the expense of purchasing or renting timecode recorders and slates compared to being able to use existing non-timecode equipment, one should definitely explore all of the post-production ramifications before blindly leaping into costly, albeit trendy, production sound decisions.

Did you know that for the first few seasons, TV shows such as “Beverly Hills 90210” did not use SMPTE timecode when recording production sound? All audio was done with the venerable Nagra 4.2, and then transferred to non-linear digital for post. Why? Because it was cheaper to do it that way, and gave them the same results!

Here is what happens when audio is recorded with SMPTE timecode. Timecode is recorded, along with production sound, on a Nagra IV-STC stereo recorder or a sophisticated DAT such as the HHB or Fostex PD4. Matching (jam sync’d) timecode may or may not be recorded on the film by means of in-the-camera keycode and an Aaton master clock module. A Denecke slate is filmed at the head of each scene, displaying a visual timecode as well as providing an old fashioned clapstick marker.

In post, the film is transferred to video in the telecine and then digitized into the non-linear editing system. Audio is resolved at the proper speed (slowed down slightly to match the picture slowdown created by telecine) and also digitized into the non-linear system. Using the timecode numbers as a “beginning of the scene” startmark or line-up reference, the editor performs a series of in-computer “audio insert edits” to sync up the dailies (matching up the picture and corresponding sync audio) for each take.

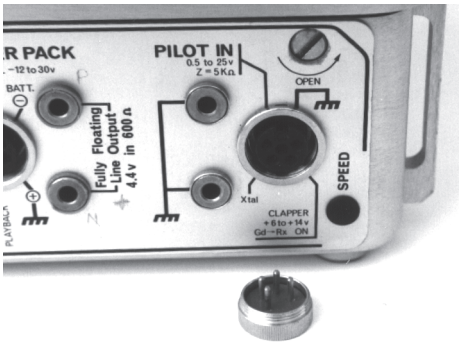
Now, examine what happens if no timecode is recorded on the audio during production. Just as before, the picture is loaded into the edit computer. Audio is resolved at the proper speed, and also digitized into the system. In order to sync the dailies, the editor goes to the picture start of the take (clapstick frame) and “parks”. Audio is advanced to the audio “marker” (the clapstick impact); and then the mark-in edit points are punched in.

Finding the start mark of the audio without timecode is easy. If one watches the visual waveform of the audio (the “optical track”), it is rather easy to locate the clapstick because it sticks out like the Washington Monument! With very little practice, an editor can sync dailies almost just as fast as with timecode, and at considerable savings of the production budget.

But without timecode, how does the edit computer keep everything in sync? The same way it always does, by means of its own internal timecode. Since most production timecode is discontinuous, it is only used for negative matching; the actual editing is done with a form of continuous timecode within the system.

It is true that without timecode, we cannot go back to the original production audio tapes and conform them with the negative for post. But why would we want to or need to? The audio coming out of the non-linear system is digital CD quality or better, far higher quality than we ever got off of a Moviola. In the old days of tape splicing, we had to re-transfer and conform the audio in order to correct for all of the damaged sprocket holes, bad splices, and unintentional edits. But since out digital soundtrack is perfect, we do not need to return to the original tapes before moving on to advanced soundtrack building.

The only step a little tricky in this non-timecode audio process is resolving. When using timecode, we normally record on the set at 30 fps non-drop, and then transfer at 29.97 non-drop in order to compensate for the fact that picture filmed at 24 or 30 fps (film speed) ends up being slowed down to 23.97 or 29.97 fps (film speed) in the telecine in order to be recorded onto videotape (which is 29.97 video speed).



If we use a conventional Nagra recording with a 60Hz sync signal, then we must transfer that audio into the edit computer at 59.94Hz. This can be very easily done by using an external sync box such as the TX-10 59.94 Crystal (available from Equipment Emporium) or a similar device. Just unplug the crystal jumper plug from the side of the Nagra and plug in the matching connector from the 59.94 external box; then play the Nagra back with resolver engaged as one normally would.

If recording with a conventional DAT recorder, the process is more complicated. Either the DAT recording must be transferred to an analog machine such as a Nagra and resolved as previously described (either on a timecode Nagra or a 60Hz Nagra); or else the DAT tape must be played back on a special DAT studio machine capable of altering its sampling rate to perform the required slowing down.

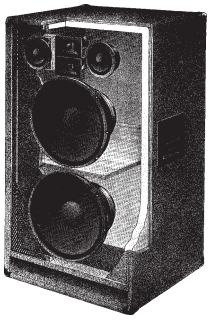
Many of the newer non-linear edit systems offer, or will soon be offering, a software routine whereby the end user can slow down the audio directly during the digitizing input process. For instance, it is a simple routine to modify the speed of an audio clip in Final Cut Pro by slowing it to 99.9 % to achieve a 0.1% pulldown.

For some applications where a protection or storage copy of the audio is desired, it is possible to transfer the audio from the original Nagra (at the 59.94Hz speed) into a digital recorder while adding an (arbitrary, not related to picture) SMPTE timecode track for future identification or locating of audio. At the same time that this protection copy of the soundtrack is created, the audio plus timecode is fed into the edit computer. This now provides a timecode for the audio so that the audio can later be conformed or reconstituted in the event of a computer crash of the edited workprint (assuming that a back-up disk is kept of the edit decision list).

This backing up of the audio track may not be necessary for most applications, but is an option that some end users feel more comfortable with.

Finally, it is important to remember that if the project is returning to the film medium (as opposed to being completed in video), one has to speed up the digital soundtrack when transferring out of the edit computer onto mag film. This can be accomplished making an intermediate transfer to Nagra (59.94Hz or 29.97 fps non-drop timecode) or digital; and then playing back at the faster frame rate (60Hz or 30 fps non-drop). Or if the facility supports it, the mag recorder could be run at 59.94Hz, so that when the mag is played back at the normal 60Hz the audio will be back in sync with sprocketed picture.

Formatting Tapes for Sync Playback

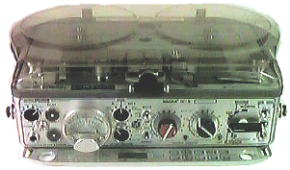


Introduction:

As many of you are aware, when film shot at 24 fps or 30 fps is transferred to video for post-production (electronic editing), the actual running time of the film is reduced by one-tenth of one percent in order to compensate for the difference in frame rates (frame lines) between cinematic projection and the continuous cathode ray scans of the video medium.

Other than rare *instances of "recreational chemical abuse", this accounts for the main reason that many rock videos are slightly out of sync.*

In order to compensate for this speed reduction that occurs during the film to video transfer, it is necessary to maintain a similar speed change in terms of our audio. That means that the playback version of the music that talent lip-syncs to must be played back on the shooting set one-tenth of one percent FASTER than the true speed of the song that will appear in the finished (video) product.



Using a timecode Nagra for playback:

If you will be using a Nagra IV-STC stereo timecode reel to reel recorder as your playback source, adhere to the following guidelines.

Prepare an **EDIT MASTER** version of your song with an accompanying SMPTE timecode of 29.97 non-drop frame. This is the version of the song that you will use in the edit bay to cut your video to.

From the EDIT MASTER, prepare your **PLAYBACK DUPES**. The dupes should be exact copies or mixdowns of the EDIT MASTER, with precisely identical 29.97 non-drop frame timecode recorded onto each copy.

At the head of the song, there should be a series of timing beeps (or countdown intro) so that the performers will be able to hit the first note of the song in unison.

Record at least a couple of song passes onto each playback dupe to save rewind time. Make at least two or three physical tapes, in case a segment of tape becomes damaged or recorded over during the shoot.

On the set, play back your dupe at the frame rate of 30 non-drop frame. This will have the effect of speeding up your music by one-tenth of one percent in order to compensate for the fact that your film footage will eventually be slowed down by that same amount.

The timecode from the playback Nagra needs to be transmitted via a Comtek wireless system to the timecode slate, since the timecode that we want to photograph needs to be the timecode of the playback tape, and has no relationship to real clock time nor record start/stop time (as it would if we were doing live dialog recording for a motion picture).

Make sure when you order your Nagra that you indicate that you will be doing sync playback, since the Nagra

does not self-resolve without a special accessory box (resolver/TCstripper) that must be added to your package, along with the Comtek transmitter system for the timecode.

Using DAT for sync playback:

The use of portable DAT recorders for sync playback has become increasingly popular.

If you will be using a consumer or non-timecode DAT recorder, then it is necessary to prepare your PLAYBACK DUPES with a monaural audio mix on one track and SMPTE timecode on the other. Consumer DAT's will only playback the tapes exactly as recorded, with no provision for speed-ups nor slow-downs.

Therefore, **DO NOT** make an exact replica of your EDIT MASTER for sync playback. Instead, arrange for the recording engineer to speed up the EDIT MASTER tape during transfer to DAT, playing back the song one tenth of one percent faster, and re-generating the timecode from 29.97 non-drop to the new value of 30 frame non-drop.

What you play back on the set must be the faster version of your song along with the faster time-code rate! Again, think in terms of multiple passes of the song on each tape, and multiple tapes in case of physical damage.

It will be necessary to transmit the timecode via Comtek to the slate, so make sure that you have all of the required adapter cables.

Using timecode DAT for playback:

When using a more sophisticated DAT recorder such as the Fostex or HHB machines that have timecode capability, it is essential to remember that tape speed and timecode speed can be independent of each other in the DAT domain.

Tape speed is determined by the sampling rate, period! A DAT tape initially recorded at 48K and played back at 48.048K will reflect a one tenth of one percent speed increase, or vice versa. However, the time code output may not change from 29.97 to 30. Similarly, a 48.048K tape that is played back at 48K might still output timecode at the 30 rate.

So make sure that the machine operator is familiar with the peculiarities of his/her machine, and remembers to re-set both the sampling rate and the timecode output rate to the appropriate settings.

If the PLAYBACK DUPE is an exact replica of the EDIT MASTER, we can assume that it is recorded at 48K with a 29.97 non-drop timecode. Play it back on the set at 48.048K, with the code reset to 30 frame non-drop.

If the DAT only does pull-downs (slow-downs), then transfer from the EDIT MASTER to the slower 47.96K sampling rate, so that when you play it back at 48K the song will be speeded up on the set by the proper percentage.

Determine whether or not the DAT machine in question automatically reconforms the output timecode to match the speeded up rate or does it keep the original timecode. In other words, does 29.97 automatically become 30, or not? Sound complicated? It is!

Very often, to eliminate confusion, the recording studio will format the PLAYBACK DUPE for proper playback at 48K/30 frame non-drop with instructions for the playback operator to not worry about pull-ups and pull-downs. But never assume. Ask. And ask again!

CD Playback:

A new process that we are developing is to prepare the PLAYBACK DUPE onto a writable audio CD, with audio on one track and correct timecode on the other. Speed and timecode changes are corrected during the transfer to CD, so that correct playback on the set is as simple as selecting a track on the CD and pressing play.

The PLAYBACK CD will contain a complete version of the song, along with a number of short excerpts for instant cueing.

ASK, BUT NEVER ASSUME:

The bottom line is that the version of the song being played back on the set must be one tenth of one percent faster than the version of the song that the video editor is going to use in the finished video.

In analog (reel to reel), that means that a song mastered with 29.97 non-drop timecode will be speeded up by the playback Nagra on the set to 30 frame non-drop.

Conventional DAT and CD must be speeded up by the studio during transfer BEFORE the tapes go to the set, so that when they are played back at their "normal" settings, they will output a version of the original song that is faster and has 30 frame non-drop timecode.

Timecode DAT demands attention to both speed and timecode changes during the playback and/or transfer process, depending on the capabilities of the make and model of the DAT recorder. Make sure that the operator is familiar with the machine and its programming routines! Make sure that you are not double-dipping by changing the playback speed of a PLAYBACK DUPE that has already been speed corrected by the studio.

SUMMARY

If shooting in video, then playback the music track in real-time (29.97). No pull-ups/pull-downs needed.

If shooting in film and editing in video, then prepare your EDIT MASTER in real-time at 29.97, but PLAY BACK the dupes speeded up to 30. Edit back at 29.97 (real-time).

If shooting in 24P progressive scan, check very carefully with Post Production on their requirements!!!

Playback Tools

Sometimes it is necessary to record live dialog while simultaneously playing back a pre-recorded track on the set.

If we were to use conventional loudspeakers, it is extremely likely that the music would bleed into the live audio. The use of highly directional speakers might solve the problem. Place them behind the actors and aim the drivers away from the mic. Use the absolute minimum playback volume that the background talend can hear; this ain't no rock concert!

Another technique is to play the music at the beginning of the scene to establish a tempo, and then mute the speaker playback just prior to the dialogue. An off-stage choreographer can monitor the playback with headphones, and lead the background dancers via body language.

Some background action (such as the band performers) may be able to wear easily concealable earphones to keep their musical pantomime in sync.

Thumpers are playback systems that filter out all but the extreme sub-woofer (bass) frequencies. Performers can hear and feel the beat; but the very low frequencies will be beneath the roll-off threshold of the live mics. For example, a 40Hz thumper would not be heard by a mic set to roll-off frequencies below 90Hz.

Induction ear-wigs are another tool for providing inaudible playback. A miniature earpiece picks up private transmissions from a wire loop antenna worn around the neck under wardrobe. This antenna connects to the headphone jack of a small receiver (similar to a radio mic). The earwig converts an electromagnetic field around the actor's head into audio. A variation of this technique uses a powerful audio amp to electrify a wire antenna that encircles the set, feeding all the ear-wigs.

What Your Crew Expects

The following is an article I wrote a decade ago about the plight of working freelance for various industrial video, and magazine television producers. Although some of the technology has changed over the years, business practices generally have remained the same. Enjoy.

It seems like, on any given day, a person can flip open a trade magazine and read all about what producers should expect from their free-lance video crews. I think that's well and good for many of the new producer/directors, and those articles may help them choose competent teams. However, this article deals with the flip side of the issue —namely, what experienced freelancers expect from their (often novice) employers.

Video has brought with it many changes in the realm of corporate and commercial filmmaking. Not only are there the obvious differences between motion-picture cameras and their electronic counterparts, but the new technology has ushered in alternative ways of thinking.

In the old days of Spectra light meters and changing bags, it was difficult for a person to advance to the rank of pro-ducer/director. Unless it was a family-owned business, the aspiring applicant had to demonstrate a solid background in the medium. Resumes boasted of experience: behind cameras; over flatbed editing consoles; pounding out page after page of scripts, and even of years spent chasing after what seem-ed like the all-important graduate degrees. People worked up the ranks. And those with the right blend of experience, creative flair, corporate conservatism and dynamic leadership eventually were rewarded with the directorial reins.

Today's corporate way of thinking is different, though. People are being dubbed producer/director on the basis of good company politics, fine intentions and a pleasant personality. They surface, it seems, from every department except film/video production. It is unbelievable how many of this new directorial cadre know hardly anything about our industry! I don't know where they all come from, or who approves their hiring, but it is frightening.

Similarly, there once existed a time when free-lance crews were selected on the basis of proven ability. Production companies looked for impressive credits on resumes, flashy demo reels and a good reputation. If the people were competent, it was taken for granted that their equipment would be up to the task.

Somewhere down the line, corporate and cable video has changed all of that. Now, in the producer's eyes, the most important factor in hiring a video crew is the **equipment**. But since the new people in charge hardly understand anything about technology, they make a decision based on the video camera the prospective cameraman owns.

If the cameraperson possesses the one brand that the pro-ducer has heard of, he or she is considered eligible for employment. If he owns a different type, even one of comparable or su-perior quality, that cameraman has one strike against him. Critically important working tools such as a good lighting and grip package seldom enter into the initial conversation. Unlike his film counterpart, the question of this individual's ability and experience only arises after the equipment category has been dealt with. The human being is considered merely an accessory that comes with the camera.

The plight of the production sound mixer is even worse. He or she has been ig-nominiously named the "video tech," and his/her sole responsibility is thought to be "to keep the cameraman out of trou-ble and to run the VTR." In his "spare time,' he *may* be called upon to put a lavalier or radio mike on someone in order to record sound. (Of course, the soundtrack is always expected to be per-fect, since sound editing is complex and costly in video.)

In terms of sound-recording equipment, the only "important" considera-tion in hiring is that the soundman have radio microphones. Other things, such as a mixing panel and a nice selection of microphones,

don't seem to matter. Like the cameraman, the soundman is something that comes along with the camera package.

As for the rest of the crew members—camera assistant, boom man, gaffer and grip - they only exist after forceful negotiation by the cameraman and re-submission/approval of the original budget. Somehow, companies are under the delusion that two people can ac-complish what normally takes a film crew of at least four or five.

There is a consensus that, because television news is video and because news teams are only two people — two are all you need for quality production. Of course, they expect better lighting than that of news, and the sound should be feature quality. Yet, only two bodies are supposed to accomplish this great feat.

But once the crew has suffered the humiliation of realizing that the primary reason for their hiring was not their Emmy nominations, but rather the fact that the cameraman happened to own the right camera, the real fun starts. In ad-dition to doing our jobs, it all too often becomes our responsibility — out of dire necessity — to turn the production set into a classroom.

Point number one: The crew must be told what the upcoming shot is supposed to be. Not the history and plann-ed future of the entire six-day shoot, but just the next shot. It sounds simplistic, I know, but describing only the single shot for the crew usually stumps a lot of the new directors. Of course, without that little tidbit of information, all we can do is stand around with our hands in our pockets and make snide comments.

When explaining a shot, especially if the director has made any slight changes, it is important to include the sound mixer — not merely the camera-man — in the conversation. Although the assistant cameraman, gaffer and grip can take their instructions from the cameraman, the sound mixer must for-mulate his own strategies for getting the best sound. A "small change" may affect his plans quite radically. If the mix-er is not kept abreast of each situation, additional delays should be expected.

Point number two: Please allow us to see a rehearsal of the action before we shoot it.

Rehearsals are a funny topic with some of the new breed. Whenever the schedule is a bit behind, they think they can save time by skipping the rehearsal. That makes about as much sense as stopping your watch to save time. The crew needs a rehearsal in order to see what the shot and blocking are going to be. Without that preview of the action, we can't guarantee the little things — such as lighting, lens focus and miking. Yet, a lot of directors become im-patient and insist on rolling the tape anyway — even though no one, not even the talent, fully understands what it is that's supposed to happen. What is the sense in wasting tape on something that everyone knows is going to be useless? (Note: I am not referring to those rare occasions when rehearsals are recorded for reference guide only, which can be a legitimate tool.)

Point number three: You can stare at your script until tomorrow and the shot still won't get any better.

A director is supposed to *direct*. Good blocking does not happen by itself; it has to be created. A surprising number of new directors take it for granted that things and people will just naturally fall into place for the camera.

Foreground action and background action have to be choreographed for those dynamic master shots. If you want a mail cart to pass through the frame, tell the mailperson what you want him to do and when. If the worktable in the back is empty, then ask one of the woman workers if she could temporari-ly move to it. Wishing and looking at storyboards won't make a good shot happen: It requires getting out there and making things happen!

Point number four: "Action? The tapes not even rolling!"

Someone has to shout "roll" and "cut:' Crew members are not mind readers. They do not know what is going on in the mind of the director, and they work with many different directors each month. It is not always obvious when a director is satisfied with the blocking and is ready to lay down a "real one:'

All too often, we hear "Action!" before anyone has bothered to say "Roll!" Nor did anyone wait for the reply, "Speed!"

In videotape, there is a 10 to 15-second delay between the time the tape operator starts the machine and the time it is okay to begin recording the scene. Not only does it take a few seconds for the VTR to stabilize, but in the event that anyone actually plans to edit the videotape, it is essential to record several seconds of "leader" at the beginning of every take in order to allow "lock-up time" for the editing computer to do its thing.

Point number five: "Tape's still rolling:"

"Cut!" is a very important word. I don't know why, but directors hate to shout that word until long after they have had a lengthy conversation with the cameraman. Sometimes, they'll even rush off to call the office first!

I realize that it may be asking a lot, but it would he nice to hear "cut;" so that the crew would know the take is over, especially in the event that the take is being stopped early.

Many times, a director will interrupt a take in order to discuss the scene with the talent. Some directors will only in-terject briefly, and then prefer that the tape continue rolling, since it takes fif-teen or more seconds to start up again. Or maybe they just like to watch them-selves in action back at the editing bay.

Sometimes, the pause turns into a long summit meeting. The problem is that the crew usually doesn't know on which interruptions that will happen. So the VTR will continue to roll, either until the director belatedly decides to announce his intentions, or the operator has to stop anyway to reload tape.

Tape operators have been threatened with slow death for having once dared to assume that a take was over when, in fact, the director claimed to be pausing only momentarily as a ploy to achieve a once-in-a-lifetime shot. That is why they all prefer to wait for the of-ficial word before punching the stop button. Only when the director specif-ically instructs the crew to "roll at their discretion" will a crew take it upon them-selves to make editorial decisions as to content.

Point number six: "According to the provisions of the Geneva Convention…"

If you took your best pet dog out to the desert for an afternoon, you'd probably bring along some water for it to drink. Well, If you take a crew out to the desert, don't forget to bring water for them.

Cold drinks are very important to the crew. Video production is very hard work physically, especially if you have to lug around equipment that weighs more than a clipboard. Every shoot must have a supply of cold refreshment on hand. There should be sodas for a "sugar fix," as well as diet drinks and plain water to quench a thirst. Fresh fruit and candy are also good snacks. Cold drinks are as im-portant to a production as tape stock—never forget that fact!

Point number seven: "Whadda you mean, '*Maybe* we'll have time for lunch?'

They say that an army travels on its stomach. A crew travels in the van, but it still gets hungry. Lunch is very impor-tant to working laborers. To a producer/director who is only out in the field one day a week, the midday meal may not matter much. For a day, you can rough it. But to a professional crew that is out working most days of the week, performing hard work 10 or more hours each day, the lunch break is sacred ground.

The crew needs a chance to sit down in a clean, comfortable environment and to relax over a healthy meal. Crew members need to nourish their bodies at the same time they clear their minds.

No matter what the temptation, no matter how much you are behind schedule, never try to cancel lunch. Not only is it against the law, but your crew will get very angry. Fatigue will affect the quality and speed of work. And besides that, they will be busy figuring out ways to "get even." One way or another, the production will pay the price!

As long as we're on the subject of lunch, it is professional etiquette for the production company to pay for the meals. When you figure the budget add a few dollars per person for lunch. Let's face it, the production company is going to end up paying for the meals directly or indirectly, so they might as well be nice about it and earn a lot of good will with the crew.

Bathrooms are also nice to have around. Usually, small production companies only think about personal con-veniences if there are important actors. Crews are just supposed to fend for themselves. If you are plan-ning to be out where there is nothing but ugly streets and locked buildings, or in the boonies somewhere, then arrange for a motor home or honey wagon.

Point number eight: Don't tell your doctor how to hold a scalpel.

A professional crew likes to be told what they are supposed to do, but not how to do it. A director working with an experienced professional—camera-man, sound mixer or gaffer - must trust in that individual's ability to do the job in the best manner possible.

Professional freelancers practice their trades day in and day out, under a wide variety of conditions. They know the limits of their equipment, and they've executed exotic techniques more times than they care to keep track. A profes-sional knows what tricks will work, and when. He or she has the experience to eyeball a situation without a monitor or a set of headphones and intuitively predict the end product.

As an experienced production sound mixer, I hate it when a director tries to tell me how to mike a situation, especially when it is clear that he doesn't possess more than a student's rudimentary knowledge. I'm not im-pressed when a director tries to show off by saying "shotgun mike" or "RF mike" There's a lot more to this job than knowing a little vocabulary; or of hav-ing played soundman once or twice on a student project. Ask me polite ques-tions, and I'll be happy to educate. However, try to tell me how to do my job, and you're on thin ice and could come out looking like the fool.

All of this is not to imply that a direc-tor cannot ask the crew for something other than what he is getting. We all have different tastes, or perhaps the scene description was a bit vague. It is fine to ask for a change in lighting, or makeup, but communicate in terms of the end product. If you want more of a low-key, shadowy look on the face, just relay that to the cameraman. Don't tell him where to move his lights, or tell the grip how to flag it. Describe to them the effect you want, and let them figure out the best way to accomplish it.

If you don't have confidence in a pro-fessional's ability—fire him! Otherwise, let him do his job.

Point nine: A shooting schedule can be easier typed than done.

It is amazing how simple it is to make movies on paper. Kodak and Sony really ought to manufacture word processors instead of film and tape.

For instance, some of the things that a producer can accomplish with a few ink marks often leave working profes-sionals speechless. Not enough money for a six-day shoot? Turn it into a four-day shoot by adding twenty more set-ups per day. Need to have the crew shoot in one location in the morning, and then be way across town for an im-portant interview? Just pencil in one hour for wrapping out of the first loca-tion, loading up the truck, driving for-ty miles in heavy traffic, stopping for lunch and being set up and ready to roll at the second site.

By only allocating a single hour for what, under the best of circumstances, would actually require at least two and a half hours, a producer can keep his show "on schedule;" even if it means delaying some unimportant transplant operation.

Setting up camera and lights takes time. Changing locations — even if it's only two doors down the hall — takes time. Loading and unloading the truck is no split-second feat of magic. Getting through traffic, and then trying to find a suitable place to park (producers hard-ly ever pre-plan for convenient parking) also eat into the clock. You can't schedule a shooting crew to be in two places without an ample interval.

Point: number ten: Just because we get our hands dirty doesn't mean we're not educated.

There is a common practice for pro-ducer/directors to think of their crew as nothing more than glorified ditch dig-gers. Because we work with equipment, some people assume that (while they went to college) all we ever did was read comic books and learn a mechanical trade.

Surprise! An awful lot of us attended film school, and we have our bachelor's and/or master's degrees hanging on our walls the same as the producer/directors do! At various times in our careers, many of us have

worked in an assort-ment of production capacities, perhaps in-cluding editor, writer, cameraman and even producer or director.

So why are we working as specialists on the crew? A number of reasons, varying from individual to individual. The money is good. The freedom of not being dependent on one employer. A lot of us enjoy working in a creative technical capacity.

Not everyone plans on remaining a specialist, either. Many of us are strug-gling along with the great unsold screenplay or are in the midst of produc-ing our own pet projects. In the meantime, though, we make decent livings by supplying the chiefs with Indians.

A director should feel free to ask ques-tions or solicit advice from members of the crew. An inexperi-enced individual will find that his or her crew knows a lot more about good filmmaking than might be sus-pected.

In fact, one novice director that I know recognizes her own limited television background, so she frequently turns to her crew for advice. Many times, the cameraman will select the angles and choreograph the action while she just sits back approvingly and concentrates on content. We don't mind helping her and it's easier on us to not be running around repeating setups. Because she knows when to step back and ask for help, the stories tend to be shot in less time and with better overall coverage. Her shows are considered among the best that any staff director in her parent company has delivered.

Point number eleven: We're not in it just for the fun and glamour. We expect to get paid.

We are professionals. That means that we do this sort of work for a living. We really don't care why a producer wants to make this or that project, nor are we impressed by the chance that it might lead to future work. We were hired to do a job, and once we have done that job to the best of our abilities, we rightfully expect to be paid in return for our effort.

As for overtime. we get time and a half (or more). And the crew is entitled to every hard-earned penny. We did not invent the schedules, nor is it our fault that the call sheet reflected someone's unrealistic fantasy of what a crew can get done in a 10 hour day.

Ten hours is a long time. If you did nothing but sit home on a couch and watch television for that long, you'd be exhausted. Working can be even harder! Travel time is another bone of conten-tion. Many producers don't seem to feel that a crew deserves to be compensated for hours spent getting to and from a location at the beginning and end of a day. If the location or meeting place is more than a half hour's drive, we expect to be paid for our time and mileage.

I have a simple rule of thumb for determining when I'm on the clock. Either I'm free to make plans and do as I please, or I am constrained in the ser-vice of the producer. That includes traveling, working, produc-tion meet-ings, site surveys, arranging for out of -the ordinary rentals, and sitting idly by the telephone all morning waiting for last-minute instructions. Depending on the specific circumstances, I may not charge him full rate, but I will invoice him for the loss of my time and freedom.

A free-lance crew assumes that they will be promptly paid. If a producer is not in a financial position to guarantee immediate payment, he should make that known up front to the people he is hiring. We are not large corporations that can afford to wait 60 or 90 days to be paid. Quite often, not only are we out our salaries, but we've had to front money for rentals and expendables. Had we planned to become investors in the project, we would have asked for agreements of limited partnership!

If the shoot is on speculation, for charity, or for a client that is slow in pay-ing the production company — tell us before you contract our services. Give us an opportunity to work out a deal that is fair for all parties involved. Who knows, maybe we will be moved enough to donate our services to a worthy cause. But, unless negotiated otherwise, a crew expects to be paid in full, *promptly.* Please, don't hire us if you can't pay us!

Believe it or not, your crew wants the project to be as good as it can. We like to be able to take pride in our work. Have trust in our abilities, treat us like flesh-and-blood human beings, and your crew will go to hell and back for you!

Street Survival: Advice before you sign that Deal Memo

Hardly a day ever passes that Tom and I are not besieged with phone calls from novices and students wanting to know how to get started in Production Sound, or from professional mixers crying the blues over how they got screwed over on their last gig.

So for the benefit of some of our younger and less combat experienced readers, here are some personal views on how to survive as an up and coming free-lancers.

Note that most of this article is written relating to nonunion shoots. Employment on union shows is not so risky, since there are strict guidelines for the producers to follow, along with the recourse of union intervention if crew members are mistreated.

Deal Memos:

Deal Memos are the term that independent producers use for employment contracts. Since the word "contract" implies something legally detailed and binding, the term "memo" is used to suggest an agreement somewhat less formal. Do not be mislead; a Deal Memo is a contract and is binding.

The problem is that it is usually not worth the effort and legal expense to try and enforce it.

Many of the deal memos that have been handed to me by Producers are nothing more than hastily rewritten Model Releases. Why a Producer would want me to sign away rights to my voice and photographed image I cannot imagine! (Behind the scenes documentaries not withstanding).

But a Deal Memo is the employment agreement that states what you are being hired to do; what you will be paid; terms of employment; and misc. details.

Make sure that the wording is specific and relevant! Do not be afraid to cross out paragraphs left over from the actors' contracts.

The memo should clearly state who the **employer** is. If it is a bona fide, long-standing production company—that is okay. But if the name of the production company is the name of the film, expect the production office to shut down forever on the last day of shooting! Get the real name of the producer, including actual address (verify it) and social security number. If the producer refuses his/her real name or address, be wary!

The memo should have **your name** on it, of course. It should detail your **job function** on the set, such as Production Sound Mixer, Boom Operator, etc. That way you do not end up hauling lumber around.

Salary. How much are you being paid? For what period of time: hourly, daily, or weekly? **Define that period of time**, such as an 8-hour workday, excluding an off-the-clock lunch break of not less than 30 minutes but not more than one hour. Or perhaps a 10 hour workday, or even a 12 hour day.

When will you get paid? State laws usually require paychecks not more than 7 days after the pay period, but check your local laws. Most crews like to be paid on a weekly basis, beginning not more than 7 days from the first day of work. Do not accept any deal where you won't be paid until the end of a lengthy shoot; that is a sure sign that the producer does not have any funds!

Do not be nice about not getting paid. If you were promised a paycheck on Friday, and that check is not there, then make it very clear that it had better be there by the next morning. Holding back your roll of dailies can help make the point; even if it means accidently turning in a blank roll... oops. And if the check still is not there the following morning, well, time to take evasive action. Leave the set, and make sure to take your equipment with you!

Overtime. Overtime traditionally means at least time and a half for any hours beyond 8 per day, 40 per week, or seventh consecutive workday. In the movie biz, these rules often get bent. Figure in your basic overtime to your rate when you agree to (or define) a long working day, or weekly rate. Your deal memo should state that you expect overtime compensation for all time beyond your basic 8, 10, or 12 hour day; as well as for weeks extending longer than the defined week.

Producers will counter with the statement that no one is getting paid overtime because no day will go overtime! To that, I point out, if we do not go into overtime—then you will not have to pay me overtime. But if you do not agree to pay me overtime when the day goes into overtime, then I will simply pack up and go home at the end of my shift and the rest of the crew can shoot M.O.S. (Of course, I never leave my equipment behind for someone else to use!)

The deal memo should cover areas such as meals (who pays?), travel expenses, gas, tolls, parking.

Travel days should be compensated, at least partially.

Airfare should be prepaid, and round-trip tickets are given to each crew member before departure. Make sure you have a return ticket in your possession, just in case the production falls apart while you are on distant location.

Hotel accommodations are to be of reasonable quality (clean, no bugs) and private room/bath. No dorms or sharing of facilities. You are entitled to your privacy and rest. Rooms should be prepaid or secured with the Producer's credit card; never your own.

Are you an employee or an independent contractor? Low budget producers will often try to entice you into being an Independent Contractor so that you will not have taxes deducted from your meager paychecks. But the IRS does not consider you to be an Independent Contractor unless you are working independently of the crew, such as an Editor in their own offices. If you work under the direct supervision of the production company, then you are not independent. If you use your own equipment or facilities, determine your own hours, choose your own locations & working conditions—then you may qualify as an Independent Contractor.

But the biggest problem that you face as an Independent Contractor is not taxes, but **insurance coverage**. What happens if you get sick or injured on the set? What if disaster strikes your equipment? Independent Contractors are self-insured. Employees are

covered by Workman's Comp and Liability provided by the Producer.

Equipment and expendables. Is the producer renting an equipment package from you and paying you weekly for it? Is the equipment totally your own, or is it from a rental house? Whose account is it under, yours or the producers? Who is providing insurance coverage against loss or damage? Is the company purchasing expendables and providing them to you, or are you bringing the expendables and billing the company on an as-used basis?

If you are engaged to act as a middleman in arranging for equipment, make sure that the rental house understands that you are acting on behalf of the producer and not for yourself. They may be willing to entrust their gear to the producer because they trust YOU, but then they will want to hold you RESPONSIBLE. Make it clear that they must be comfortable with the producer's credit app and insurance, and that you are not personally vouching for your client.

By the way, never put up front money or your credit card to cover company bulk purchases. If you have to front for expendables, then they belong to you until the company reimburses you, at a profit!

Term of employment. The deal memo should state the start and completion dates of the project. Are you being hired for the duration of the show, weekly, or on a day-to-day hire? How many days prior to the start date does the production company need to notify you in the event of postponement or cancellation? After all, you are turning away other work being offered to you because the producer has booked you! Will you be compensated for delays? What about compensation for prep days, location scouting, and travel days?

Deferred Salary. Read free. Do not seriously expect to be paid any real money after the picture is completed and "sold". You have better odds of winning the lottery! Whatever compensation you are going to get, you will receive at the end of each shooting week. After that, forget it.

So make sure you that you are willing to settle for whatever is offered to you up front.

But if you feel lucky, and decide to gamble on a Deferred deal, then play it for as much as you can get. Do not defer straight salary; if you have to wait and gamble, then it should be for at least double or triple your normal rate. Expendables, expenses, and equipment rental are not deferrable!!

Priority of deferred payment. Your deal should state that you get paid as quickly as anyone else. Investors who put up cash should not be paid off any sooner than professionals who put up their time and skill. Your services are equal to cash, since the producer would otherwise have to PAY for them.

The few times that I have had to accept a partially deferred deal, I have added a clause stating that all of the soundtracks that I record are **my property and copyright** until my contract is paid off in full—only at that time will the ownership and rights to the sound recordings revert to the producer. The producer is prohibited from entering into any agreement with any outside party that constitutes sale or transfer of ownership of the sound recordings until my contract is paid in full. That prevents a producer from legally selling off the film to a distributor, and then claiming that the amount of the sale was insufficient to pay off the deferred debt. The distributors purchasing the rights to the film always claim that any deferred contracts are between the crew and the producer.

I also record a copyright claim at the head of every tape.

Ownership of the sound recordings serves as mechanic's lien and may give you a little more leverage to insure payment. But don't count on it. Lawyers usually only take your case if really big money is involved.

Most importantly in your deal memo, **pay attention to who signs** it. An approval by a production assistant is not considered binding by the producer. It must be signed by the producer if deferred payments are involved. The producer or a senior production manager must sign any deal memo. Make sure that the production manager is, in fact, empowered to make the deal.

The issue of deal memos is a complicated one, and **this article should not be used in lieu of consulting with an attorney**. Many fine line legal issues are involved, and the laws vary widely from state to state.

Be careful in what you sign and what you agree to! Make sure that the deal memo covers not just what the producer expects from you, but what you expect from the producer! The more specific, the better. If you are not using the services of a lawyer, then write everything out in plain, common day English. A judge is more likely to rule in your favor if the intent of the agreement is clear, even if it is not in legalese. When your agreement starts sounding like it was written by a lawyer, then legal loopholes are more likely to be applied.

Always **get a signed copy** of the agreement, including initialed pages and initialed cross-outs. Better yet, ask to take an unsigned copy of the deal memo home for a couple of days to look over. Explain that you never sign any contract without consulting with your lawyer. Even if you do not have a lawyer, that will give you a chance to show the agreement to a couple of seasoned professionals who might spot something fishy or badly misworded.

FAQ's Regarding Audio Packages...

I recently purchased a Sony TRV900 camcorder and am looking for a basic sound package to get started with in order to shoot documentary (and the occasional, bill-paying wedding). What would you suggest? And, of course, I am on a tight budget!

I am looking for a good on-camera shotgun mic, maybe a boompole, a wireless, and whatever else you think I might need. Be merciful, I just graduated!

Let's start at the camera end. Since you recently purchased your TRV900, we can assume that it one of the newer generation of TRV900 cameras.

Very early TRV900's were notorious for bad audio; it was extremely difficult to plug in any form of external mic input. Even our world-famous XLR-DV cables, with their built-in capacitors, were only sometimes successful in eliminating the buzz & humm. BeachTek spend months coming up with the DXA4S adapter box, and even those only got good results some of the time. It seemed like every camera body was different!

Sometime after the first year, Sony figured out that there was a problem and solved it without fanfare nor announcement. There was no change on the model designation, no special markings, nothing to indicate that the newer cameras were improved.

Anyway, back to your camera. To feed professional microphones (with XLR connectors) into a prosumer camcorder (with a stereo mini external mic jack), you will need some sort of adapter.

If you are using only one mic, then you could get by with just an adapter cable. Our basic cable sells for only $18 and will put the mono mic signal onto both your camcorder tracks (if you are shooting with Canon or Panasonic). But for Sony, you will need the XLR-H8/DV adapter cable with built-in capacitors or else you may experience noisy crackling, buzz, and humm at the mic jack input.

For the most versatility, we suggest either the BeachTek DXA4S, Studio One BP-PRO, or the SV XLR-PRO adapter box. They provide for one or two XLR inputs, switchable for mic or line level, mono or stereo, with volume controls to reduce (not amplify) either incoming signal.

(The DXA-4S does attenuate the signal somewhat, which is not a problem with hot mic signals, but may be a problem with some radio mics, lavs, and ENG type shotguns.)

A good, all purpose shotgun mic would be the Audio Technica AT835b. The 835 is a very good short (pattern, not inches) ENG style (electret condenser) shotgun. It can power from an internal AA battery or from external 48v Phantom (available from mixing panels and full-size professional camcorders, but not from most prosumer models).

(The Studio One and SV XLR-Pro boxes work better with the AT835b.)

To mount the AT835 to your camera, you will need a shockmount. The best are the universal mini-mount from LightWave, and the K-Tek KSM shockmount

The inexpensive (and most popular) AT8415 universal shockmount is intended for use on a boompole, but Equipment Emporium has a brass adapter so you can use it directly on your camera.

You will need a short XLR jumper cable to go from your mic to the adapter box.

Don't expect great sound from any mic mounted on-camera. It will sound much better than the original camera mic, but you will not get "feature quality" dialog from a mic several feet in front of the subject.

For Hollywood caliber sound, you need to boom the mic from a couple feet overhead!

The RoboPole is a well-made metal pole that is economical abd almost as lightweight as the expensive carbon fibre types. The short 7 1/2 ft version is ideal for news & documentary; the long 15 footer is best for theatrical filmmaking; and the medium 12 footer is general purpose.

In terms of wireless, your choices would include the Audio Technica Pro88 ($214); the Samson UM1 ($400), the Samson UM32 ($550), and the Audio Technica ATW-U101 ($700).

The Pro88 is the least expensive, quality wireless that we like. It is VHF, with 2 switchable frequencies, and comes with a great sounding lavalier. The system is somewhat short range, clean line of sight (though sometimes you can get long range, but you cannot bank on it!).

The Samson UM1 and UM32 systems are UHF and diversity. They have amazing range without dropout. The UM1 is single frequency; and the UM32 has 32 user switchable frequencies.

The Audio Technica ATW-U101 is 100 channel, UHF, true diversity and is the best built. It is a rugged, metal constructed unit that is beefier & heavier duty, since it was intended for broadcast camcorders and studio film production.

You will need a few more accessories to round out your package.

Headphones are critical. Without a reliable way of monitoring audio, you will never know what you are getting. It's like shooting video blindfolded! The best headphones are the Sony MDR7506.

It would be good for your boom operator to also hear. Check out our wireless boom buddy or the mini duplex cable.

And don't forget some XLR mic cables. At least a thirty footer for the boom mic.

A shoulder bracket adds stability to your rig as well as presenting a professional look. Kind of important for event videography.

What kind of equipment would you suggest for an independent feature film?

A basic sound package for theatrical production starts with a decent mixing panel such as a Behringer or Mackie offering at least 4 XLR mic inputs with 48vPhantom, 3-band EQ, and Aux sends (for feeding the boom operator). One should also have a portable cart to set it up on. AC is usually available on sets, but remote locations may require an invertor and a 12v battery pack.

At least two or three condenser shotgun mics. The AT4073a is an excellent, general purpose short shotgun. The AT4071a is a condenser full shotgun, ideal for exteriors. The AT4051a or AT4041 are short range but extremely low echo -- perfect for tight interior shots. Exterior conditions will call for a good windscreen, such as an Equalizer or full zeppelin system.

At least one good dynamic handheld mic, for loud sound effects and also for narration.

One or two boompoles, at least 12 footers. Make sure there are suitable shockmounts for each shotgun mic, such as the AT8415 or KSM. (Zeppelins include their own mounts.)

Lavaliers for body worn as well as plant mic applications. Plant mics require an open sound with good reach, such as the MT830, AT899, and ECM77. Open sounding mics also cut better with overhead miking.

Proximity lavaliers such as the Countryman B3 and the ECM44 are useful for isolating actors from background noise or other actors.

At least two good wireless units, such as the Samson UM32 or the Audio Technica ATW-U101.

An assortment of mic cables, including 30 footers and some 50's. Use a duplex cable to connect to the boom operator.

Professional headphones for the sound mixer and boomperson.

The type of recorder that you should bring is dependent on the budget and the style of post production. Standard choices include recording straight to video; Nagra 4.2; Tascam DAP1; and the Fostex PD4 timecode.

A small minidisk or DAT is useful as a backup recorder or to hide on an actor.

What minimal sound package would you suggest for doing a wedding?

Event videography is obviously different from theatrical production.

To begin with, make sure that all of your camcorders (primary and backup) are equipped to accept XLR mic inputs. You may need to use an audio adapter box with camcorders that only offer a stereo mini mic input.

Three mics that are essential include a decent short shotgun, a good quality wireless, and a handheld. In addition, you will need an extra mic for a small audio recorder (or spare camcorder).

If your camcorder has XLR inputs with 48vPhantom powering, my choice for shotgun would be an AT4073a.

If the budget is tight, and your camcorder (with adapter box) does not support Phantom powering, then go with a decent ENG shotgun such as the AT835b.

The wireless should be UHF diversity and capable of good distance. It should also allow you to change channels in order to get around local interference. We suggest the Samson UM32 or the Audio Technica ATW-U101.

Choose a lavalier on the wireless that offers strong reach and pickup. You want to be able to eavesdrop on entire conversations, not just the single voice of the person wearing it.

The handheld mic could be the Shure VP64AL dynamic omni, or the Audio Technica ATM29 dynamic cardioid. Both are very impressive broadcast microphones. Add a customized mic flag with your company's and the client's logos proudly displayed!

For the ceremony, deploy the wireless on one of the three principals (bride, groom, clergy). Or hide the mic in the center to pick up all three voices.

Record the wireless onto one channel of your camera, and use the shogun on the second. Do not mount the shotgun onto the camera at this point, in case you need to pan around to shoot various cut-aways. Keep the mic pointed at the best or main source of sound.

For protection, you should also rig an extra mic and record the audio of the ceremony onto the second camera or a small audio recorder (minidisk, MP3, etc.)

If you lose a few seconds of picture during the ceremony, you can always edit in some neutral cut-aways or close-ups to cover, so long as you still have the important audio!

During the reception, use the handheld mic (with flag) for guest interviews. It will hold back all the background noise and music!

The shotgun mic will cover the general activities. The wireless will allow you to follow around a family VIP as they greet guests, etc.

Use the audio recorder (or spare camcorder) to record the band performing entire songs. That allows you to create a smooth montage of dancing without the music cutting in and out every few seconds when the shots change!

Most importantly, never forget to use professional headphones and to always listen to what you are recording.

The new recording formats...

Now that I've got it, what am I going to do with it?

Cynical old mixers that we are, we have to caution the new generation about getting overly excited over the new recording media. We grew up using Nagra 4.2's, pioneered the Nagra IV-STC's, and are trying to keep up with all of the new DAT's and other digital toys.

Which is fine. Change is good. Change is inevitable. (And its good for rentals.)

However, before producers start banging their electronic drums and demanding the latest digital toys, they need to examine the practical aspects of location sound recording.

For decades, the motion picture industry was satisfied with the analog signal-to-noise ratio of the venerable Nagra 4.2, operating at the slow (compared to music) tape speed of 7 1/2 inches per second. Audio might have been improved by rolling at 15 inches per second, but the studios determined that it was not necessary.

Because there are two ways of looking at the concept of signal-to-noise. The engineers in their white labcoats and anechoic testing chambers contrast residual traces of electronic hiss against saturated test tones recorded on the tape. Makes for great conversation at a cocktail party.

Production Mixers, on the other hand, look realistically at the difference between low level dialogue and high level traffic or air conditioner noise. We do not even come close to worrying about the residual noise of four-strand versus two-strand mic cable, nor whether our recording medium has 70 or 170 dB of range.

Our problem is separating the voices from the background. Having twice as much signal-to-noise in our recorder only means that we can capture the hum of the lights and the whoosh of the air conditioner with greater fidelity than sound cutters ever heard before! But the signal-to-noise between usable dialogue and unwanted ambiance remains the same.

Far better to put one's budget into reliable recorders, better mics, larger variety of mics, improved acoustics in set design, quieter lighting, and highly skilled (better paid) boom operators.

That will contribute more to the overall quality and usability of the production tracks than an investment in fancier location recorders.

But DO take advantage of the better recording formats in POST, where signal-to-noise will make a difference, since we are adding studio perfect elements such as music and sound effects.

Digital Recording

Digital recorders are used far more often than Nagra's.

Today's choices include the new Nagra V and DEVA hard drive recorders, which record directly onto a removable (albeit expensive) hard drive; the Fostex PD6, which records onto a special DVD; the Fostex PD4 timecode DAT; the Tascam DAP1 non-timecode DAT; and various Sony minidisk pocket recorders.

In addition to the digital audio recorders, many corporate and independent productions capture their audio directly onto the camcorders.

A few notes regarding audio in the digital domain...

Setting Levels with Digital

When you record too hot on a Nagra, the audio distorts gradually. But in the digital domain, overmodulation is unacceptable and yields horrible results. In digital, zero MEANS zero tolerance!

On the other hand, if you record too low on a Nagra, the sound suffers from inherent tape hiss and system noise.

Digital is relatively free from that problem. Therefore, when recording in digital, it is wiser to record low and allow yourself plenty of headroom in case of loud peaks. Record your reference tone around -18 to -24, and consider that your average level for normal dialog.

Many manufacturers pre-set their reference tone generators to -12, but that is really too high a setting for motion picture work. Allow yourself plenty of headroom for handling a dramatic scene.

If you are recording onto a camcorder, the problem becomes even more difficult. Most prosumer camcorders are not designed with good audio in mind. The pre-amps may be noisy and the meters are calibrated with "fudge factors" built-in, so that one cannot be sure of what the meters actually mean. Camcorders tend to distort easily, even though the meters indicate that you are below zero (the meters are center weighted, slow to react, and may not judge the presence of extreme low or high frequency peaks).

If you have the time, the best technique is to record some dialogue (that includes normal conversation, a whisper, and a shout) at incremental volume levels onto your camcorder. Then transfer the footage to your edit system, and play back the takes to determine the best settings to use for your production.

Another technique, if you have to shoot fast & dirty without the chance to do recording tests, is to feed conversational dialogue into the camera with the Auto Level Control turned ON. Watch the meter levels in the camera to see where average dialogue is placed. Then switch the ALC to OFF, and manually set the input level so that dialogue fluctuates in the same meter range as it did when the ALC was engaged.

If you are in a situation that calls for extreme low volume and loud volume within the same take, then

borrow a technique from the news gathering profession. Stagger the volume on your two audio tracks, so that one track records softer than the other. One track will capture the quiet sounds while the other track is scaled back and ready for the loud outbursts. The editor simply has to splice together the best selections.

Keeping it all in sync

Except for the real cheap stuff, almost any digital recorder should maintain a constant sampling rate (and crystal accurate speed). That means that the audio should remain in sync with either the video camcorder or a cystal controlled film camera.

If you are shooting in film, and editing in film; or if you are shooting in video and editing in video -- then all you have to do is just transfer the audio directly to mag or into the editing computer.

But if you are shooting in film, and editing in video, then it is no longer a real-time situation. The film changes speed slightly during its transfer to NTSC video. Therefore, the digital audio has to be time changed as well.

High end digital recorders allow you to make this "pull down" internally: you record at a sampling rate of 48.048 and then play back at the slightly slower rate of 48.000 during transfer.

The simpler digital recorders do not have this feature, and only record and play back at the same speed.

You will need to correct (slow down) the speed (pitch) by 0.1%. This can be done within Final Cut Pro (Modify>Speed) or with other audio software.

Personally, I would not worry about trying to transfer the audio via a digital output. Just use the regular analog outputs (XLR, RCA, mini) and let your editing computer digitize the audio to its own standards. You will not hear any difference in quality; and you will save yourself tons of grief and frustration! I mean, think about it, when you play an audio CD at home -- you are really sending an RCA analog output signal to your amp and speakers!

Recorder selection

At this current time (Sept 2003), the low budget filmmaker has a choice of using DAT or minidisk.

Hollywood is using timecode recorders utilizing DAT, DVD, or removable hard-drives -- but those systems are considerably more expensive (seven to fifteen grand). So let's deal with the more affordable choices...

DAT versus minidisk. From a strictly technical viewpoint, the DAT offers better frequency response and no artificial compression.

Minidisk records the top layer of audio fully, and compresses the (less significant) lower layers gradually -- similar to the way in which we hear. The end result is an excellent recording similar to CD audio!

DAT would be preferable for precision recording of complex sound effects as well as for high tech surveillance, since all of its audio layers would be accessible if the editor really had to dig down deep to isolate a subtle sound in the background.

But for general dialogue and motion picture sound effects, we never need to strip away the top audio layers (not an easy task to do without a very specialized workstation).

The most popular non-timecode DAT recorder is the Tascam DAP1 (under $2000). It is about the size of a textbook, and features two XLR inputs with 48v Phantom power. A DAT tape can record up to two hours at the best sampling rate of 48 k.

Operating controls resemble a simple cassette deck (play, record, pause, FF, rewind, etc.). Headphone monitor is 1/4-inch stereo. Powering is from AC or from an internal rechargeable battery pack.

Other popular DAT recorders include the Sony TCD-D10 and the HHB PDR1000. (Both units are no longer made.)

The Sony TCD-D8 and PCM-M1 are walkman type DAT recorders. About the size of a large folded wallet, these recorders are small enough to be worn under wardrobe by the actor, if necessary.

The small DAT's have the same potential frequency response as the larger units, but lack the quality of the mic pre-amps. Inputs are mini plug (not XLR) and require adapters.

The minidisk recorders are even smaller than the walkman DAT's, and considerably less expensive. Models of the minidisk recorders seem to change almost monthly, so I will not list them. A minidisk can hold 80 minutes of stereo audio. Most minidisk recorders do not offer an external mic jack, so be careful when choosing a unit!

Mic inputs are mini jacks, so you will need an adapter for XLR. Output is usually a mini jack as well, although some units offer USB.

However, the HHB MD500 minidisk recorder is similar in size to the DAP1 DAT recorder, and offers XLR inputs with 48v Phantom along with other professional features,

A favorite technique of mine is to plug a high quality lavalier directly into the minidisk (or walkman DAT) and hide it on the actor; in addition to the actor's radio mic. The wireless provides the audio for "dailies", while the minidisk provides the editor with a clean soundtrack (devoid of electronic interference) for use in post. This replacement dialog track is essential if the actor is working around electronic props or machinery that interfere with wireless mic transmission.

R-5	"Mixers on the March" No-Cash Productions	Oct 11, 1998 mxr: F Ginsburg

example of box spine of 1/4-inch audiotape box

Tape Boxes & Labels

A key aspect of professionalism is presentation.

All of your recorded tapes should be neatly and clearly labeled as to content and recording format.

In addition to marking the box and tape reel itself, remember to always record a verbal head slate at the beginning of every reel of tape.

Your verbal slate should include:
"Sound Roll number"
"Production number / title"
"Production company / studio"
"Date / Production Mixer's name"
"The following is a negative *XXX* **dB headtone, recorded at** *XXX (ips, or kHz sampling rate)* **on a** *(brand & model of recorder)* **with a** *(60 Hz sync pulse / 30fps non-drop timecode / etc.)***"**
Follow this slate with 30 seconds of headtone.

The outside of your audiotape box should be labeled on the front or back, and along one spine when feasible.

The spine should contain:
reel #, title, production company, date, mixer.

The main label should include:
reel #, title, production company, date, mixer, headtone level, recording format, speed or sampling rate, sync or timecode format. Any special notes about this recording. Any special notes about the content (ambiance tracks, sound effects, wild lines, etc.)

Many mixers use computer generated adhesive labels that they create for each show. All of the constant info is pre-printed, and blank space is left for variable data such as reel number, date.

Labels are affixed to the reel or cassette itself, as well as to the outer box.

examples of box and reel labels

Roll number_____ Date_____
No-Cash Productions
"Mixers on the March"
mixer: Fred Ginsburg
Nagra 4.2 mono
7 1/2 ips 60 Hz sync
headtone [] -8 dB []other_____
[] tails out [] head out

Roll number_____ Date_____
No-Cash Productions
"Mixers on the March"
mixer: Fred Ginsburg
Nagra IV-STC stereo
7 1/2 ips
headtone [] -8 dB []other_____
[]30 fps []29.97 []non-drop []drop
[] tails out [] head out

Roll number_____ Date_____
No-Cash Productions
"Mixers on the March"
mixer: Fred Ginsburg
[] PD4 []HHB []_____
[]48.048kHz []48kHz []44.1kHz
headtone []-18 []_____
[]30 fps []29.97 []non-drop []drop
[] tails out [] head out

Guide to Mics for Film/TV (from Audio-Technica, Sennheiser, Shure, ElectroVoice)

For tight interiors where echo is a problem, such as bathrooms, kitchens, small offices, foyers, etc...	**AT4051** condenser 48v capsule system (cardioid head). Very mellow, smooth response literally reduces audible echo. Very low handling noise; great to use on a boompole. Built-in low cut filter. Ideal for tight 2-shots. Moderate working reach around 1.5 to 2.5 feet overhead. **AT4053-ele** companion capsule provides very tight hypercardioid pattern, well suited for isolating a single actor where noise and echo are problems. Often used as a plant mic and car mic. **AT4041** condenser 48v cardioid is pretty close in performance to the AT4051, but is priced a couple hundred dollars less. If you can't have a 4051 in your kit, at least have one of these! **AT3031** condenser 48v cardioid. Very affordable low-echo mic for those on a strict budget. Senn **MKH40** condenser 48v cardioid. Wider angle than the MKH60 short shotgun, making it ideal for echo reduction. Excellent audio, but requires careful mounting to avoid handling noise.
General purpose for soundstages, practical interiors...	**AT4073a** condenser 48v "short shotgun". Tight hypercardioid pattern. Flat off-axis response facilitates using mic angle to balance dialogue levels between actors. Better front reach than "traditional" short shotguns. Built-in low cut filter. Slightly more echo than 4051, but much mellower than traditional short shotguns. Low handling noise; great on a boompole. Overhead working reach up to 5 or 6 feet. Mic can also function well exteriors, especially for 2-shots. Senn **MKH60** condenser 48v "short shotgun". Flat off-axis response. Low cut filter. tighter pattern and slightly more echo than the MKH40, but excellent reach and audio quality. Overhead working reach up to 5 or 6 feet. Mic can also function well exteriors, especially for 2-shots. This is the successor to the old venerable MKH416 short shotgun. **MKH416** condenser 12vT or 48vPhantom "short shotgun". This workhorse was the standard of the industry for decades! Unlike the newer MKH60 and AT4073a, the 416 uses interference tubes and is NOT flat off-axis. Strong front reach but hollow & distant off-angle response. Early versions power from 12vT (standard and red-dot "Nagra" versions). Later mics available in 48v Phantom.
Best for exterior dialogue, sports, multi-camera audience shows, and high overhead interiors...	**AT4071a** condenser 48v "full shotgun". Very tight, ultradirectional pattern. Flat off-axis response facilitates using mic angle to balance dialogue levels between actors. Better front reach and far less echo than "traditional" long shotguns. Built-in low cut filter. Slightly more echo than 4073a, but still mellow enough to use indoors when needed. Low handling noise; great on a boompole. Overhead working reach up to 8 or 9 feet. Also used by law enforcement for long range surveillance (they don't require *broadcast quality* at those ranges). Senn **MKH70** condenser 48v "full shotgun". Flat off-axis response. Low cut filter. tighter pattern and slightly more echo than the MKH60, but excellent reach and audio quality. Overhead working reach up to 8 or 9 feet. This is the successor to the old venerable MKH816 long shotgun. **MKH816** condenser 12vT or 48vPhantom "short shotgun". This workhorse was the standard of the industry for decades! Unlike the newer MKH70 and AT4071a, the 816 uses interference tubes and is NOT flat off-axis. Strong front reach but hollow & distant off-angle response. Early versions power from 12vT (standard and red-dot "Nagra" versions). Later mics available in 48v Phantom.
ENG Shotgun Mics for broadcast news, docu, corporate, and film schools...	**AT897** electret condenser short shotgun. Uses internal AA battery or 48v Phantom (improved performance with 48v). Excellent general purpose shotgun mic for interiors or exteriors. Tight hypercardioid pattern. Lightweight, ideal for camcorders or boompole. Built-in low cut filter. "35mm Feature quality" dialogue from 1.5 to 4 feet overhead; ENG audio from greater distances. Comparable to modular systems costing nearly twice as much! **AT835b** electret condenser short shotgun. Uses internal AA battery or 48v Phantom (improved performance with 48v). Excellent general purpose shotgun mic for interiors or exteriors. Tight hypercardioid pattern. Moderate echo indoors, typical of interference tube shotguns. Very low handling noise; great to use on camcorder or boompole. Built-in low cut filter. "35mm Feature quality" dialogue from 1.5 to 2.5 feet overhead; ENG audio from greater distances. Very rugged construction. **AT815b** electret condenser long shotgun. Uses internal AA battery or 48v Phantom (improved performance with 48v). Excellent long reach mic for exteriors, sports, and documentary. Possible increase of echo when used indoors. Very tight ultradirectional pattern. Very low handling noise; great to use on camcorder or boompole. Built-in low cut filter. Very rugged construction. Good companion mic to AT835b.

ENG Shotgun Mics for broadcast news, docu, corporate, and film schools...	**Senn K6/ME66** electret condenser capsule short shotgun. Uses internal AA battery or 48v Phantom (improved performance with 48v). Excellent general purpose shotgun mic for interiors or exteriors. Tight hypercardioid pattern. Moderate echo indoors, typical of interference tube shotguns. Very low handling noise; great to use on camcorder or boompole. Built-in low cut filter. “35mm Feature quality” dialogue from 1.5 to 2.5 feet overhead; ENG audio from greater distances. Very rugged construction. Part of Sennheiser's K6 modular system, that allows use of screw-on various capsule “mic heads” onto the K6 powering base. **K6/ME67** electret condenser long shotgun. Uses internal AA battery or 48v Phantom (improved performance with 48v). Excellent long reach mic for exteriors, sports, and documentary. Possible increase of echo when used indoors. Very tight ultradirectional pattern. Built-in low cut filter. Very rugged construction. **K6/ME64** electret condenser cardioid configuration. The ME64 head is a cardioid pattern. Not enough reach for most boom applications, but an excellent choice for handheld interview, narration, subtle sound effects, and music. **K6/ME62** electret condenser omnidirectional configuration. Excellent choice for handheld interview, narration, subtle sound effects, and music.
General purpose dynamic handheld mics...	**AT804** dynamic omni handheld. Good for interviews, location narration, sound effects (especially loud crashes/explosions, since dynamic mic tends to compress these sounds for better recording). **ATM63HE** dynamic hypercardioid handheld. Good for interviews where background noise is a problem (used during SuperBowl broadcast). Excellent narration mic. Great for “stand-up” vocal performances (music/comedy). This mic was the “90210” band mic, the O.J. Trial witness stand mic, and was used for the Presidential Debates. The **ATM29HE is less expensive and very close in sound and appearance.** ElectroVoice **RE50** dynamic omni handheld. Broadcast industry favorite reporters mic for decades. Good wind suppression and internal shockmounting. Shure **VP64AL** dynamic omni handheld. Sleek, long handled omni mic for handheld reporting & interviews. Shure **SM58** dynamic cardioid handheld. Classic silver-domed rock 'n roll favorite. Great for on-stage singers, but lacks the reach for interview work. Shure **SM57** cardioid is intended for acoustic instruments, though some performers favor them for warm vocals.
Stereo music and sound effects...	**AT825** electret condenser X-Y wide pattern stereo. Uses AA battery. Terminates in a pair of balanced XLR 3-pin connectors. Simple Left/Right outputs eliminates M-S decoding and future phasing problems when mixing to surround sound formats. **AT822** is similar to above, but mic head uses only one standard XLR 3-pin mic cable. Adapter cable converts from XLR to unbalanced 3.5 stereo or dual 1/4” plugs for direct use with small format video or DAT. **AT835ST** looks like a shotgun mic, but is a 48v condenser stereo mic offering M-S, wide X-Y, and narrow X-Y. The **AT815ST** is similar, but more reach and narrower pattern. The **AT849** boundary mic is a UniPlate® 48v condenser mic X-Y stereo pattern.
Narration, vocals, music, radio spots, animation dialogue, books on tape...	**AT4050** multi-pattern condenser 48v studio mic. Omni, cardioid, and figure-8. Best mic for studio recording of audio only. **AT4033/CL** is a high quality cardioid condenser mic for those who do not need multi-pattern. **AT3035** is a lower cost, cardioid condenser mic with the appeal and appearance of a studio mic. **ATM63HE/ATM29HE** are dynamic, cardioid mics excellent for narration where background noise and acoustics are a problem. Shure **SM7** studio cardioid dynamic. ElectroVoice **RE20**. Popular narration and radio station “d.j.” mics.

Production Time Sheet

EMPLOYEE: _____

PAY PERIOD: **PRODUCTION:**

DATE	TIME IN	MEAL OUT	MEAL RTN	TIME OUT	NOTES

Sound Report: [] print circled takes only

Title ____________________ Roll # ________ Date:____/____/____ Sheet # ____ of____

Company ____________________ Recorder type & sn ____________________

Prod Number ____________________ Tape speed or sampling rate ____________________

Mixer ____________________ Head Tone ____________________ Xfer Equiv ____dB =_____

Boom ____________________ Sync: Hz or timecode rate________________ [] non-drop [] drop

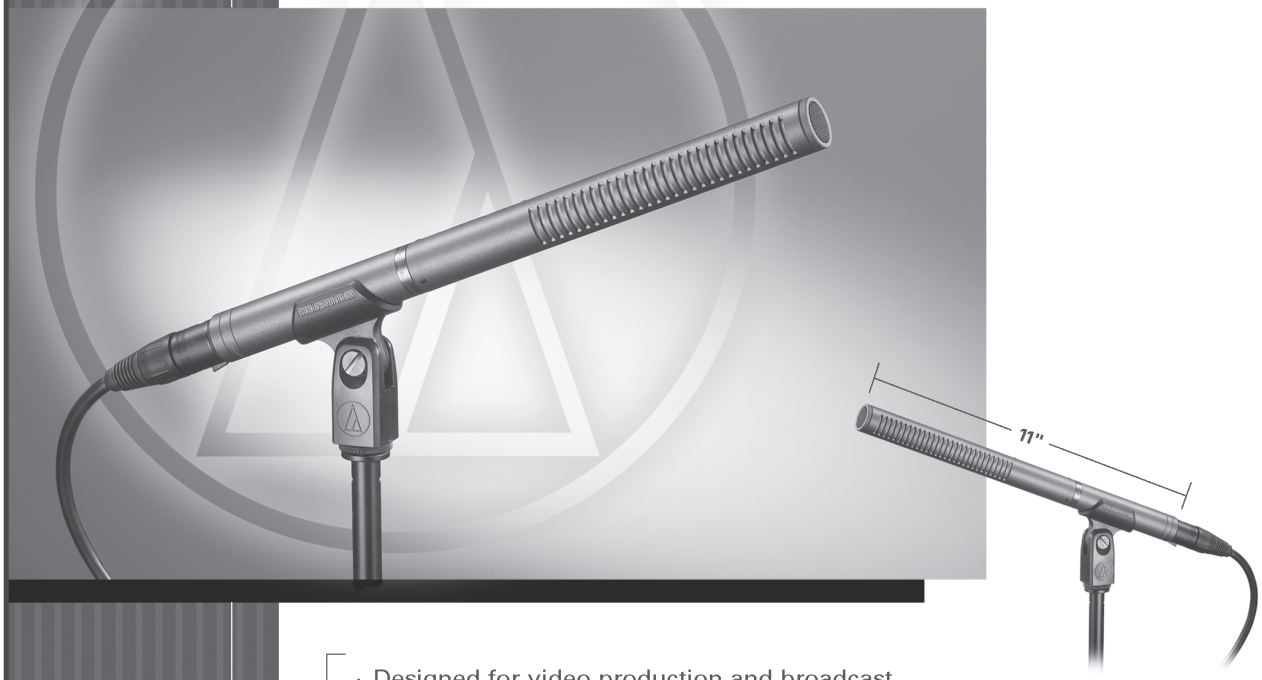
Location ____________________ Notes ____________________

Scene#	Take	Index	Left Channel	Right Channel	Comments	Timecode

A high performance shotgun,
short enough to stay out of the frame.

AT897

Short Shotgun Microphone



FEATURES & BENEFITS

- Designed for video production and broadcast (ENG/EFP) audio acquisition
- Short length (11") ensures mic stays out of the frame — even when used with compact digital cameras
- Line+gradient design provides the narrow acceptance angle desirable for long-distance audio pickup
- Smooth, natural-sounding on-axis audio quality
- Excellent off-axis rejection of sound arriving from the sides and rear of mic
- Two versatile powering options: phantom and internal AA battery
- Switchable low-frequency roll-off for improved dialogue capture and reduced pickup of unwanted sounds
- Lightweight, rugged construction adds negligible weight to camcorders
- Integral 3-pin XLRM-type output connector
- Includes windscreen and microphone stand adapter

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NAGRA V

(This presentation provided courtesy of Nagra USA.)

For over 50 years NAGRA recorders have established a well-deserved respect from audio professionals all over the world. No other name carries the industry-wide reputation of reliability, audio quality, engineering precision and aesthetic details. As a digital successor to the renown analog NAGRA IVS-TC and replacement for the portable timecode R-DAT recorders, the new NAGRA V carries on this time-honored tradition. The result is a two-track direct-to-disk location recorder using a removable sealed hard drive that records 24 or 16-bit linear PCM data at selectable 44.1 or 48kHz (88.2 and 96kHz optional) with audio stored in a standard broadcast WAV format. A compact lightweight frame with a user-friendly front-panel make the NAGRA V ideal for over-the-shoulder operation.

The NAGRA V has four analog inputs (2 mic and 2 line) each routable to either audio track, as well as two AES channels. With a convenient pre-roll / pre-record feature, selectable for up to 20 seconds, you will never be too late to start a recording. Auto record allows automatic start recording depending on the settings of different parameters. Once the parameters are set, put the machine in record mode and the recording will start once the requested level and length of any incoming sound is obtained. Metering is achieved by means of a digitally driven analog modulometer with a memory peak hold feature using a real moving needle combined with a signal-present LED for each channel. Headphone monitoring can be stereo / mono (left only, right only) with an internal M/S decoder. In addition to a tape return stereo input for video camcorder monitoring, the NAGRA V also has a built-in monitor speaker. The audio quality offered by the NAGRA V is exceptional, thanks to the design of the entire analog chain and careful attention to signal processing.

Today, the challenge for a manufacturer of location recorders is not only to produce the highest quality acquisition, but to deliver it on a media that is reliable and directly adaptable to existing computer interfaces, in a non-proprietary format that is easily understood by the host software. Responding to this challenge NAGRA has chosen the standard 2.5" ATA-5 compliant Hard Disk Drives in a removable drawer, to store audio in a digital linear Broadcast WAV format, providing direct file access. Dowloading files is very fast and simple by connecting the removable drawer to a PC or MAC using USB2 or Firewire interface cable.

Additional feature of the NAGRA V include dithering from 24 to 16-bit for backup on a DAT or CD recorder and optional available SMPTE Time Code generator and chase synchronizer for all current frame rates and video master reference with pull-up and down for post production. Other available options are 88.2 / 96kHz high sampling, analog limiters for the microphone preamplifiers, double metering and a full line of accessories.

NAVCOM, a Windows based application, provides graphical feedback and operational control through the RS422 interface. It includes remote meter display, a directory containing detailed information of each take, metadata and file naming and the ability to change Time Code, synchronizer and audio settings.

The light snap-on 65w Lithium Ion battery pack with its own charger circuit supplies a full 10 hours of autonomous power. Other powering options include a battery pack for 8 standard “D” cells or rechargeable Ni-Cd and Ni-Mh cells. The NAGRA V can also accept external DC up to 14.8V from a standard AC/DC adapter or external batteries.

Manufactured using a brushed anodized aluminum chassis, the NAGRA tradition of rugged reliability in hostile environments is guaranteed. Its operation and features offer a friendly transition from traditional analog to newer digital technologies making the NAGRA V the most practical and flexible NAGRA ever.

The standard rotary main function selector controls the main operational features of the machine, keeping the ergonomics of traditional NAGRA models.The

menu-assisted set-up for all the operating parameters of the NAGRA V is made using the keys on the front panel, in conjunction with the LCD display. Specific settings can be stored and instantly recalled by using templates.The shift key allows for a multitude of practical direct access functions - even while recording. RECORD takes priority from any operational mode and it will never-ever record over an existing take.

Technical specifications:

RECORDING

Data Storage medium	Removable 2.5" Hard Disk Drive
Recording method	Linear PCM
File Format	Broadcast Wave File BWF (WAV)
A/D and D/A conversion	24 bit Sigma Delta
Sampling Frequencies	44.1 kHz, 48 kHz, (88.2kHz and 96kHz optionally)
Recording capacity	Almost 1hr of 24 bit 48 kHz per GB
Pre-recording buffer	User programmable up to 20 sec.
Level meter	Digitally driven analog modulometer with HOLD feature

INPUTS

Microphone inputs	2 x XLR (Dynamic, “T” Powering and +48V Phantom) Expandable to 4 if required using external accessory
Microphone input sensitivity	0.2, 10 and 40 mV/Pa
Line inputs	15 pin miniature “D” connector
Line input sensitivity	1.5V to 4.4V for 0 dB recording
Digital input	Using special cable on 15 pin miniature “D” connector
Input filters	“Flat”, “LFA” and “SPEECH”
External reference	15 pin miniature “D” connector or BNC (Word clock, video, etc.)
Limiters (optional)	Selectable for each channel

OUTPUTS

Analog line output	2 x XLR (4,4V max)
THD at 1 kHz	0.1%
Dynamic range	Typical 98 dB
Frequency response	30Hz to 20 kHz (+0 dB -1 dB) at 48kHz
Headphones	Stereo ¼” Jack with level adjust
Mono output	Banana connectors (600 Ohms)
Digital output	XLR AES-3 Pro
Time code IN/OUT	5 pin LEMO
M/S Decoder	Switchable
Dither	Menu selectable 24/16 bits on Inputs and/or Outputs

POWER SUPPLY

Li-Ion pack	10 hours of operation (7 hours on 8 “D” cells)
DC power	6 - 13,8V on 4-pin XLR

GENERAL

Dimensions	290 x 220 x 115mm (11.4 x 8.6 x 4.5")
Weight	2.75 kg (6 lb) without battery box
Quality control	Every machine is tested: 1 cycle 14°F to +140°F for 12 hours
Power consumption	10W
Relative humidity	From 10% to 99% (non-condensing)

WARRANTY Three years from date of purchase

NAGRA

Based on a rich tradition in the analog and digital domains, Nagra produces professional audio products which enjoy an international reputation for quality and reliability.

Nagra II - 1953

The Tradition Continues…

Nagra V - 2003

NAGRA USA, INC.
http://www.nagrausa.com

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mail@nagra.com

Nagra USA is a division of NagraVision SA,
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About the author

Fred Ginsburg, Ph.D. C.A.S. is a Production Sound Mixer with over 30 years of experience recording sound on feature films, episodic television, commercials, corporate, law enforcement, and government. A member of the distinguished Cinema Audio Society, he has published over 90 articles in the leading trade magazines, wrote the instructional sales catalogs for three major industry companies, and is authoring a textbook. He currently instructs part-time at two major universities.

Fred is the president and founder of Equipment Emporium Inc, a firm specializing in professional audio and video equipment sales, rentals, and manufacturing; as well as Education & Training.

Dr. Ginsburg has instructed seminars and courses nationwide and internationally for universities, broadcasters, trade associations, and major organizations. He is an instructor for California Commission on Peace Officers Standards & Training and the Law Enforcement Video Association; and is active with the University Film & Video Association.

Feel free to contact Fred Ginsburg at his office if you have any questions relating to production sound or are interested in arranging for a seminar. Voice: (800) 473-4554 E-mail: eqe@earthlink.net

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Audio-Technica US manufactures absolutely superb professional mics at affordable prices, and provides unparalleled customer support! Really a nice bunch of folks to deal with.

Canon USA

Mackie Designs Inc.

Denise Ohio independent filmmaker and author of ***Five Essential Steps in Digital Video***

University Film and Video Association if you teach production, you should definitely become a member.

Ligaya, Vince, and Sage the support team back at the ranch!

Guide to the Nagra 4.2
and
Production
Sound Recording

by Fred Ginsburg

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