The Functions of Sound for Television

Without sound, programs become silent movies. All sounds on television serve one or more of the following four functions:

• Voice track
• Music and sound effects
• Environmental sound
• Room tone

The voice track is usually the primary means of getting a message to the viewer’s ears and may be considered the most necessary audio of a program. The voice track is the sound created through dialogue or narration. The narrator often watches the video portion of a documentary and speaks the narration into a mic attached to an additional recorder. In the editing phase, the narration track is synchronized and recorded onto the same tape with the video.

If the viewer sees the narrator speaking, this is typically called an on-camera narration. Off-camera narration, also called voiceover (VO), is when viewers hear but do not see the narrator of a program (Figure 6-1). In broadcast journalism, the narrator may be the reporter or an on-the-street eyewitness describing the event or situation that the videographer is shooting. For example, a reporter asks one resident of a local neighborhood...
to describe what the tornado sounded like as it bore down on his home. As the resident talks, the camera pans the destruction caused by the tornado.

**Production Note**

On a remote shoot, sometimes the dialogue picked up by the mics is weaker than the background sounds. In a dramatic program, for example, the live background engine noise of race cars at a NASCAR race makes the dialogue between two characters in the scene very hard to hear. Later, the actors view the scene and re-record their dialogue in a sound booth—essentially lip-syncing with themselves. This process is called automatic (or automated) dialogue replacement (ADR), or may simply be called “re-recording.” Look for the job title “ADR” or “Re-recording” in the end credits of a movie.

Music and sound effects help set the mood and enhance the action of a program. The emotion of a scene is dramatically enhanced with properly selected and timed background music. Sound effects can be created by the production team or be purchased on tape, DVD, CD, or downloaded from the Internet.

Complete silence is artificial and should rarely, if ever, be found in a television program of any type. Every location has a certain amount of normal sound associated with that particular location. This is the existing sound that a production crew may find in an environment when shooting occurs. For example, the sounds in a scene that takes place in a classroom may include papers rustling, pens tapping, the faint sound of hallway noise, and the hum of fluorescent lighting fixtures. If the expected environmental sounds are not present during the shoot, they may be added during post-production editing to help establish the setting in a dramatic production. Care must be taken to prevent the volume of environmental sound from becoming distracting.

There are two terms used to describe environmental sounds: background sound and natural (nat) sound. The difference between these environmental sounds depends on their importance in a shot.

**Background sound** is environmental sound that is not the most important sound in a shot. If it’s in the background, some other sound is in the foreground—such as the voice of actors performing the dialogue in a dramatic production. Since background sound is not the most important sound in the shot, it must not overpower the foreground sound in a shot. The production crew must be aware of background sound and organize the shoot to make sure the background sound remains effectively in the background.

**Natural sound**, or nat sound, is environmental sound that is important to the topic of the story; it may often be the most important sound in the shot. For example, a feature story about a blacksmith should include some shots with natural sound of his hammer hitting the metal on an anvil. Nat sound is usually captured on a secondary recording called B-roll, either before or after the shot containing the voice track. During the editing phase of production, the nat sound is placed on a track underneath the primary audio of the program.
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**PRODUCTION NOTE**

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PRODUCTION NOTE

In broadcast journalism, a reporter can record voiceover narration at the studio in a sound booth or conduct an interview in a quiet location (to ensure good sound quality) about a topic which includes action. In each of these situations, B-roll shots with nat sound become very important in the editing process to provide visuals and sounds of the action associated with a story. The B-roll video with nat sound audio of related action shots can be mixed with the voice track from the A-roll. As the clips with nat sound are inserted into the story during the editing process, the nat sound audio level can be controlled to ensure the volume doesn’t overpower the reporter’s voiceover. A talented and experienced reporter can plan/pace their voiceover to incorporate the nat sound during pauses in speech (at commas or periods in scripted narration). This way, the nat sound, which was recorded because it is an important part of the topic/event covered, becomes an important piece of raw material the reporter can use to build the story.

Nat sound is environmental sound that helps call attention to what a reporter is saying and entices the viewer to continue paying attention to the story. Nat sound is only the environmental sound that supports the story. Where things get tricky is the processing that must sometimes be done to make sure relevant nat sound is present in a recording, without the unwanted background sound.

Visualize This

A busy roadway with holiday weekend traffic, horns honking, loud music playing, and motors revving are all part of the background sound to a traffic report. The reporter and photog must be very careful to make sure the reporter’s audio is in the foreground and the traffic sounds are in the background. However, this same traffic scene can be shot without the reporter, taken back to the studio, and used as nat sound behind the reporter’s voiceover. The traffic sounds can be coordinated with the reporter’s voiceover, so that the honk of a car horn happens right when the reporter finishes a sentence and acts as an “exclamation point” for the story. When natural sound is used this way, it is placed with the visual that accompanied it in reality.

If nat sound is extracted from a video recording and manipulated, ethical issues arise about modifying reality. Using a shot and its accompanying sound to illustrate the reporter’s narration is ethical. The only acceptable alteration of audio in news is to reduce the volume of nat sound to better hear the voices of those speaking.

Room tone is the sound present in a room, or at a location, before human occupation. Room tone is the “sound of silence” in the shooting environment. If shooting on location, it is important to clear the set for a few minutes after the equipment is set up. Once all the talent and crew have left the location set, turn on the recorder and record at least three minutes of the existing environmental sound. Having the environmental
sound of each location recorded is useful when editing the program. The environmental sound may be used to cover unwanted sounds in the background of a scene that were not noticed while shooting. Using the environmental sound of a location creates a much less noticeable audio edit than if true silence were used.

Assistant Activity

Listen to the silence of a room. Although you have probably never noticed it, the silence of different locations varies greatly. Go to your bedroom; remain perfectly still and listen. Do the same in the family room and in the backyard. You will soon realize that the “silence” is notably different in each location.

Place a good pair of stereo headphones with full earmuffs over your ears and do not turn on any sound. Listen to that kind of “silence.” All of these “sounds of silence” are surprisingly unique and they help to define the video image’s environment from an audio perspective.

Sound Frequency

Sounds are generally divided into three groups: low-frequency sounds, mid-range sounds, and high-frequency sounds. Most people are familiar with common band instruments and the sounds they create. Common instruments are used in the following examples of the three frequency categories:
• Low-frequency instruments include the bass guitar, bass drum, and the tuba. A bass vocalist is also categorized in the low-frequency range.
• Mid-range sound frequency instruments are trumpets, clarinets, and French horns. Alto and tenor vocalists fall within the mid-range. The human speaking voice is generally in the mid-range, as well.
• High-frequency sound is created by flutes, piccolos, and soprano vocalists.

Types of Microphones

A microphone is the piece of equipment that picks up sounds in the air and sends them to the mixer or recorder. Fundamentally, all microphones work the same way. Sound waves in the air hit a thin surface inside the mic, a diaphragm or generating element, which then vibrates. In the most common types of mics, the vibration moves a tiny wire back and forth through a magnetic field creating an electrical signal, Figure 6-2. This electrical signal is sent through the mic cable to an amplifier or a recorder.

Talk the Talk

The term “microphone” is commonly abbreviated as “mic” or “mike.”
Microphones may be classified by the type of generating element (surrounded in a magnetic field) each uses:

- Diaphragm that vibrates a coil.
- Thin piece of coated film that vibrates a coil.
- Thin piece of metal foil.

Mics can be differentiated by examining the frequencies of sound each best captures. Some mics pick up certain frequencies of sound better than others. The audio engineer’s goal is to match the right mic to the right frequencies of sound. All microphones are not created equal—you typically get what you pay for. Low-cost gear often yields results that are less than satisfactory.

### Wired and Wireless Mics

Another classification of mics is “wired” or “wireless,” which refers to how the signal gets from the mic to the recorder.

A wired mic is attached to the recorder by a cable. Cables can span a significant distance (at least 200 feet) without ill effects to the audio signal. With extremely long runs of cable, such as from the press box in a football stadium to a remote production truck in the parking lot, an amplifier may be put in the line to keep the signal strong. Wired mics and their cables are very reliable. However, the greatest disadvantage of wired mics is their cables. Performers using wired mics must be mindful of the mic cables and avoid tangling their feet in the cables. Additionally, when wires are run along the floor, they pose a tripping hazard and must be taped down securely. Removing the tape at the end of a shoot and re-coiling the
cables neatly is also a substantial task that must be done carefully to avoid a huge spaghetti-like mess of wires, which would take a great deal of time to untangle.

Wireless mics have a practical advantage over wired mics in that there is no wire to run to the recording unit. A wireless mic has a short cable that runs from the mic to a radio transmitter with an antenna. The transmitter is sometimes built into the mic itself. The transmitter sends the audio signal through the air, via a radio wave, to a receiver that is on or near the recorder. The receiver picks up the transmitted signal from the air and sends it through a short cable to the recorder, Figure 6-3. A primary advantage of a wireless system is the freedom of movement it allows the performers—they do not need to be concerned with tripping over mic cables while performing. Additionally, the audio engineer does not need to lay many feet of mic cable, tape it to the floor for safety, and pull up the cable to re-coil it at the end of the shoot.

Some may consider wireless mics to be the best choice for all applications, but this is not the case. Wireless mics transmit and receive signals using a radio frequency, which is very effective as long as no one else in the vicinity uses the same radio frequency. Wireless mics are prone to interference from walkie-talkies, baby monitors, CB radios, heavy machinery, and other wireless mics operating at or near the same frequencies. Use wireless mics whenever appropriate and practical, but always keep a backup of wired mics and mic cable.

**PRODUCTION NOTE**

When recording a theatrical event, there is an excellent chance that the stage performers or the theater’s tech crew will be using their own wireless mics on the actors, as well as on the stage crew’s headsets. Always check the frequencies used by the theater and compare them to the frequencies of your equipment. If the frequencies are close, use wired mics instead.

**wireless mic:** A mic that uses a short cable to connect the mic to a radio transmitter with an antenna, or the transmitter may be built into the mic itself. The transmitter wirelessly sends the signal to the receiver, which sends the mic signal through a short cable to the recorder.
Dynamic Microphones

The generating element in a dynamic mic is a diaphragm that vibrates a small coil that is housed in a magnetic field. It is a rugged mic with good sound reproduction ability, Figure 6-4. Dynamic mics are designed to “hear” different sound frequencies—the pitch of a sound, not its volume or strength. The dynamic mic most commonly found in a television studio is designed to pick up sounds best in normal speaking voice frequencies. They are not designed to mic musical instruments or accompanying vocals. The dynamic mics used in a studio setting do not pick up high- and low-frequency sounds as effectively as the mid-range sounds of speech. Using a mic that picks up mid-range sounds to mic musical instruments or singing stage performers would result in music that lacks good sound quality and reproduction.

Condenser Microphones

The generating element used in condenser mics is a thin piece of metal foil or coated film. This type of mic requires an external power supply (usually a battery) in order to operate, Figure 6-5. Condenser microphones are also called electret condenser mics. They can pick up a greater range of sound frequencies than dynamic mics and good condenser mics are usually more expensive.
Ribbon Microphones

The ribbon mic is the most sensitive type of mic used in television. A thin ribbon of metal surrounded by a magnetic field serves as the generating element in this type of mic. At one time, ribbon mics were the only type found in commercial radio stations. In television applications, a ribbon mic is most commonly placed on a talk show host’s desk. These mics are now primarily used in music recording studios. Superb sensitivity is a great advantage of this type of mic. However, the fragility of the generating element is an expensive disadvantage of the ribbon mic. An accidental bump of the mic itself or the “pop” produced from the rush of air released when pronouncing a “p” sound could break the ribbon inside the microphone. In recording studios, a barrier made of shaped wire covered with a piece of nylon is placed between the ribbon mic and the talent. This pop filter protects the mics from explosive “t” and “p” sounds, and catches moisture and rushes of air before they hit and damage the diaphragm of the ribbon mic, Figure 6-6.

Talk the Talk

The pop filter is sometimes referred to as a “spit guard.”

Non-Professional Microphones

The microphone built into low-end camcorders should not be used in professional recording scenarios. It has a very limited pick-up range and, when inside a room, produces audio that sounds like the person speaking has a bucket over his head. This microphone picks up the grinding sound of the zoom lens motor, the rubbing or knocking sounds of the operator’s

Figure 6-6. Using a pop filter protects the generating element of a microphone. The generating element may be damaged by the sudden rush of air created when speaking or singing “t” and “p” sounds. (Popless Voice Screens)
boundary mic: A microphone used to pick up a sound on a stage or in a large room and is most commonly a condenser type. Boundary mics are usually placed on a table, floor, or wall to "hear" the sound that is reflected off hard surfaces.

parabolic reflector mic: A very sensitive mic that looks like a satellite dish with handles and is designed to pick up sounds at a distance.

Specialized Microphones

The boundary mic is most commonly a condenser type, previously described. Boundary mics are becoming the most common way to mic an entire stage or large room. These mics do not look like any others that most consumers commonly see. They work on the principle that sound is reflected off hard surfaces, and are usually placed on a table, floor, or wall, Figure 6-7. They have a very low profile, rising no more than an inch above the surface they are placed upon.

A parabolic reflector mic is a very sensitive mic that looks like a satellite dish with handles, Figure 6-8. This type of mic is designed to pick up sounds at a distance. The operator simply aims the mic at what he wants to hear and the sound is received very clearly. The pick-up range of a parabolic reflector microphone depends on the refinement of the electronics on the inside of the mic. The sensitivity of the electronics inside the mic is directly related to the cost—the more sensitive the electronics, the higher the purchase price.

Figure 6-7. The boundary mic is commonly used to mic a stage for a dramatic performance.

Figure 6-8. The parabolic reflector mic is capable of clearly picking up sounds from a significant distance.
The parabolic reflector microphone is often seen on the sidelines of professional football games and picks up the grunts and crashes of bodies slamming against each other, which add to the excitement of the game. When using these mics at a professional sporting event, an experienced operator knows when to turn off the audio feed from the mic. Some of the vocalizations it can pick up are not likely to be appropriate for prime-time television.

Pick-Up Pattern

Microphones are further classified by their pick-up pattern. Pick-up pattern refers to how well a mic “hears” sounds from various directions. An omni-directional mic has a pick-up pattern that captures sound from nearly every (omni) direction equally well, Figure 6-9. The only weak area for this type of mic is the sound coming directly from the rear of the mic.

Mics with a uni-directional pick-up pattern pick up sound from primarily one (uni) direction, Figure 6-10. A uni-directional mic is also known as a directional mic or a cardioid mic. The term “cardioid” is derived from the shape of the pick-up pattern; it is shaped like a valentine heart. The point of the heart is aimed at the source of the sound. Sounds from the sides and rear of the mic are not heard as well, or not at all. The cost of a uni-directional mic is usually proportionately related to how far away it can pick up sounds.

**Figure 6-9.** The omni-directional mic picks up sounds from nearly all directions.

**Figure 6-10.** A uni-directional mic has a pick-up pattern in the shape of a heart, thus the name “cardioid.”
A hypercardioid mic has a narrower and longer pick-up pattern than a cardioid mic.

A supercardioid mic has an even narrower pattern.

A shotgun mic is an extremely narrow pick-up pattern.

Feedback is a high-pitched squeal that occurs when a microphone picks up the sound coming from a speaker that is carrying that microphone’s signal.

Directional mics are available in various degrees, or grades, of directionality, Figure 6-11. A hypercardioid mic has a narrower and longer pick-up pattern than a cardioid mic. A supercardioid mic has an even narrower pattern. More directional still is the shotgun mic. Sometimes, the shotgun mic is literally mounted on a rifle stock and even has a sight to help in aiming it at the sound source. The parabolic reflector mic is a version of a directional mic.

Directional mics are most important when recording music. If the performer uses an omni-directional mic and steps in front of the band’s speakers, a high-pitched squeal is emitted. The squeal is called feedback. Feedback occurs when a microphone picks up the sound coming from a speaker that is carrying that microphone’s signal, Figure 6-12.

A feedback loop is created when:

1. Sound enters the microphone.
2. The sound is transmitted to an amplifier.
3. The signal from the amplifier is sent to a speaker.
4. The sound from the speaker goes through the air and back into the microphone.

Each time this circle is made, the pitch gets higher and louder and more painful to the human ear. If the cycle is not stopped, the speakers could be
permanently damaged. To prevent feedback, the sound coming from the speakers needs to be blocked from hitting the mic. Using a directional mic decreases the likelihood of feedback because of its narrow pick-up pattern.

**PRODUCTION NOTE**

To stop the high-pitched squeal of feedback:
- Move the mic away from the speaker.
- Bury the mic in your armpit.
- Turn down the amplifier.
- Turn the speaker away from the mic.

Determine what caused the feedback and take precautions to ensure it does not happen again.

**Mics on the Set**

A mic stand is the most commonly known device designed to hold a microphone in place. In television, however, the mic stand is not often seen. A talk show host may have a microphone on a desk stand, but that mic is often only a prop.

A *hand-held microphone* is designed to be held in the hand, rather than placed on a stand or clipped to clothing, but can be placed on a stand or boom. Hand-held mics are sometimes referred to as a *stick mics*.

A *boom* used in television production is essentially a pole that is positioned over the set with a microphone attached to the end of the pole. The mic picks up the sound of the talent performing on the set. Any type of mic can be attached to the end of the boom as long as the connectors will mate. The goal of the boom operator is to get the mic as close to the talent as possible without dipping the mic into the top of the picture. A *fishpole boom* is a type of boom that must be physically held over the heads of talent, Figure 6-13. This requires that one or both arms be extended over the operator’s head and held in position for the duration of the shot.

**PRODUCTION NOTE**

If using a fishpole boom, most operator’s arms tire quickly and the mic begins to dip into the frame of the picture. A simple solution is to obtain a microphone stand that can be raised to a height of 6–8 feet. Take the fishpole boom to an audio store and purchase a microphone stand mic clip that fits the shaft of the fishpole boom. Place the boom into the mic clip on the stand, positioned about 4 feet from the back end of the pole. Let the stand be a fulcrum to bear the weight of the pole, and you can adjust the height of the mic by swiveling and raising or lowering the mic-end of the boom. No more tired arms!

Large studios have the same type of stand for booms, except the stand is often more like a camera tripod on a dolly and can roll easily. If you have a spare tripod and dolly, you may be able to be creative and devise something to hold the fishpole boom securely onto the top of the tripod.
**Talk the Talk**

Many students ask about a “boom mic” during class discussion. No such piece of equipment exists. If you were to walk into a professional audio store and ask where the boom mics are located, the staff would have no idea what you are asking for. Any mic that is attached to a boom is a boom mic. Therefore, the phrase “boom mic” refers to how a mic is used and not a piece of equipment.

**Mics on Talent**

The smallest mic worn by talent is the *lapel mic*, sometimes called a *lav*. It is attached at or near the breastbone of the talent with a small clip or pin, Figure 6-14. The cord is routed under the clothing to be less obvious. The most common lapel mic is about the size of a pencil eraser.

*lapel mic:* The smallest type of mic that can be worn by talent and is attached to clothing at or near the breastbone with a small clip or pin. Sometimes referred to as a *lav*.
Handling and Care of Microphones

Proper microphone etiquette requires that reasonable judgment be used to ensure longevity of the audio equipment and the safety of staff and talent. This applies to everyday use and handling, and the storage of equipment. Microphones should be handled very carefully.

**PRODUCTION NOTE**

Any noise or action that can damage a human eardrum may also damage a microphone. Being slapped in the ear with a cupped hand is the equivalent of slapping the head of a microphone. This action could burst the eardrum. Treat a microphone the same way you would treat the ears of someone you care for.

Below are a few general guidelines:

- Never blow into a microphone to see if it is working. A strong burst of air can damage or tear the microphone’s diaphragm, just as it can damage or permanently impair the human eardrum.
- Do not shout into a microphone. Extreme sound vibrations can stretch the diaphragm out of shape, just as these vibrations can stretch the tissue of the eardrum. This causes a mic to receive sound vibrations improperly, if at all. The tissue of the human eardrum can be stretched by the extreme sound vibrations at a loud concert, which results in temporary hearing difficulty for hours after the concert.
- Never let anyone put their lips directly on the mic. The saliva that enters the mic moistens and softens the diaphragm. This obstructs the microphone’s ability to receive sound vibrations just as sound vibrations are muffled to the eardrum when water is trapped in the ear after swimming.
- Do not slap the head of the microphone to hear the muffled thump through the speakers. The increased air pressure can tear the microphone’s diaphragm, just as being hit with a cupped hand over the ear can burst the eardrum.
- Do not exhale directly into or inhale through the microphone. Exhaling into the mic forces moisture in and that moisture softens the diaphragm. Inhaling through the mic transfers all the bacteria inside the mic to you through your mouth. Inhaling through the mic also creates a loud hiss in the sound reproduced.
- Never swing a mic by its cord. The centrifugal force created can easily separate wired connections inside the mic cable connector and prevent any sound from being reproduced.

**Proper Use of Microphones**

Many amateur bands use mics that have a silver or black ball of mesh on the tip, Figure 6-15. Beneath the wire mesh is usually foam that protects
the diaphragm of the mic. The foam provides a barrier to moisture and rushing air when a performer places their lips directly on the mic. Speaking or singing with your lips directly on a mic is not necessary for sound reproduction, but it is a style commonly seen in popular music videos. Amateur bands, trying to emulate popular bands, imitate this style while performing. Singing enthusiastically with lips pressed on the mic pushes saliva into the black foam under the surface of the wire mesh mic tip. After a performance, all of the mics are typically packed up and stored until the next practice or show. The moisture on the foam surface is stored in the dark, at room temperature, and away from any airflow. This is the perfect environment for bacteria growth. From practice to practice or show to show, it is very unlikely that the same mic will be used consistently by the same person. The next band member to use the mic will place his lips directly on the bacteria-infested mic while singing. That person will very likely exhale and inhale right through the mic while performing. In an effort to keep the performers and equipment germ-free and healthy, do not allow talent to place their lips directly on the surface of a microphone.

When using a hand-held mic, hold the mic firmly in your fist and keep your hand and fingers still. Moving or adjusting your fingers produces a very distracting sound that is picked up by the mic. Place the knuckle of your thumb against the sternum of your chest to properly position the mic while reporting. Figure 6-16. A common mistake made by novice reporters when interviewing is to point the mic at the subject/guest when asking a question, and then point the mic at themselves as the guest answers. Even though this is backwards, it is a very easy mistake to make.

When interviewing children, do not stand over them. Being on their level creates a much more pleasing picture and children are less likely to be intimidated when an adult is physically at their level. A reporter should squat down so that their head is at or below the level of the child’s head. The child can also be raised up to the reporter’s level using a stool to achieve the same effect.

When running cables on the ground, never place an audio or mic cable beside an electrical cable. Electrical cables produce magnetic fields, which can cause interference in the audio signal. The interference may be detected as a persistent hum heard through the audio system. In some circumstances, it may be unavoidable for an audio cable to be near or have to cross a power cable. Keep the runs of cable apart for as much of the length as possible. Limit the portions of cabling that are close in proximity to as few as feasible. If the cables must intersect, make sure it is at a 90° angle.
Impedance

In television, a microphone’s purpose is to create a signal that is sent through a cable to be recorded. There are two different kinds of signals that mics can send: high impedance and low impedance. A high impedance (HiZ) mic is typically inexpensive, low-quality, and cannot tolerate cable length much longer than 8’. For these reasons alone, high impedance mics are not usually found in TV studios. A low impedance (LoZ) mic is typically of high-quality, more costly than a HiZ mic, and can tolerate long cable lengths.

Levels

It is important to know the three levels of audio, Figure 6-17, because the output of one level cannot be connected into the input of another. The result is either massive distortion or no sound at all. The three levels of audio are:

- **Mic level**: The level of audio that comes from a microphone. It is designed to be sent to the “mic in” on a recorder or mixer.

**high impedance (HiZ)**: A type of mic that is typically inexpensive, low-quality, and cannot tolerate cable lengths longer than 8’.

**low impedance (LoZ)**: A type of mic that is costly, high-quality, and can tolerate long cable lengths.

**mic level**: The level of audio that comes from a microphone. It is designed to be sent to the “mic in” on a recorder or mixer.
**Line level**: The level of audio between pieces of audio equipment. For example, the level of audio going from the output of a CD player to the input on an amplifier.

**Power level**: The audio level from the output on an amplifier to the speaker.

**Mic mixer**: A piece of equipment that combines only the microphone signals into a single sound signal.

**Audio mixer**: A piece of equipment that takes the sounds from a variety of sources, such as mics, a CD player, or tape player, and combines them into a single sound signal that is sent to the recorder.

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**Mixers**

A *mic mixer* combines only the microphone signals into a single- or dual-channel sound signal. An *audio mixer* is designed to take the sounds from a variety of sources, such as mics, a CD player, or tape player, and combine them into a single sound signal that is sent to the recorder, Figure 6-18.

In both the mic mixer and audio mixer, each signal coming into the mixer can be controlled with a *potentiometer*, or *pot* for short. The operator can increase or decrease the strength of each signal, so each audio source is properly balanced in the output signal. A pot is usually a knob or a slider. As a knob, it functions like the volume knob on a stereo. The signal coming in gets stronger as the knob is turned to the right. If the control is a slider, the signal coming in gets stronger as the slider is moved farther away from the operator.

**Figure 6-18.** The audio mixer has a different pot for each audio input. The volume unit (VU) meters indicate the levels of the audio.
potentiometer (pot): A knob or a slider control that regulates the strength of a signal.

volume unit meter (VU meter): A meter on either an audio or mic mixer that indicates signal strength.

When using either of the mixers, the operator gauges the signal strength by watching a VU (volume unit) meter, Figure 6-19. VU meters take two forms:

- One type looks similar to a car’s speedometer, with a scale and a needle to indicate the signal strength.
- Another type is a series of LEDs that light as the signal gets stronger.

**PRODUCTION NOTE**

Do not assume that red LEDs on a VU meter signify over-recorded sound. Different manufacturers use different colored LEDs to mean different things. Always check the operator’s manual for your mixer.

To operate either mixer type:

1. Activate the sound source. Play a CD or instruct the talent to talk.
2. Bring up a single pot until the sound reaches a desired level on the VU meter.
3. Repeat for each individual microphone or sound source. All the pots are typically not adjusted identically. The pot running a naturally loud voice is set much lower than the pot for a soft-spoken person’s microphone. All background music should be relatively low or it drowns out the dialogue in the scene.
4. Bring up the pot labeled “master” to send the mixed signal out of the mixer to the recorder.

By adjusting the potentiometer, the audio engineer makes certain that the audio signal is appropriately strong. If the system uses analog technology, the master VU meters should fluctuate between –3 and +3 dB. If the system is digital, the VU meters should hover near –20 dB.
**PRODUCTION NOTE**

When monitoring the master VU meters, the needle should never touch the far right edge of the meter. This is called “burying the needle,” or recording “in the mud.” Burying the needle means the audio is being over-recorded. Over-recorded audio is distorted. This cannot be fixed in post-production. Over-recording or under-recording the audio when shooting raw footage is an error that a professional usually makes only once. This mistake requires that everyone involved in the production reconvene to re-shoot the otherwise perfect footage. Calling everyone back for a re-shoot and gathering all the necessary equipment is so expensive that most people do not make this mistake a second time.

It is critically important for whoever is recording the audio to wear a good set of headphones that cover the entire ear, like earmuffs. This is the only way to accurately monitor the quality of the audio being recorded. The small foam “ear bud” style or collapsible earphones many people use with their personal audio players are totally inadequate for this purpose.

**PRODUCTION NOTE**

A confusing situation that a novice audio technician may encounter involves recording a stage performance. Do not take a direct feed off the audio board of the theater, if offered by the theater's audio engineer. Set up your own microphones on the stage. While connecting to the audio board is the easier option, you run the risk of recording poor quality audio. If recording the audio from the theater’s audio board:

- The recording has only the sounds picked up by the audio mixer’s microphones. Any performers who are not specifically speaking or singing into a microphone are not heard at all. The same holds true for any instruments not playing into a mic. The live audience hears all the instruments, but the audience of the recording hears only what is played into a microphone.

- The audio mixer mixes the signals from the mics and sends them to an amplifier to be sent out over the theater's speakers. The purpose of the theater’s audio mixer is to reinforce and amplify the sounds, so the live audience hears them well. The live audience hears a blend of live, electronically mixed, and amplified sounds. When recording a performance, your purpose is to record all the sounds in the theater. This is not possible when the mixer sends only some of the sounds—just those picked up by microphones.

- Any mistake made by the audio mixer is clearly evident in your recording, but you will bear the responsibility and blame for the audio quality.

**Automatic Gain Control**

The automatic gain control (AGC) is a circuit found on most consumer video cameras that controls the audio level during the recording process. If
the sound is soft, the AGC turns the recording levels up, while also bringing up a noticeable tape hiss and background noise. If the sound is loud, the AGC turns the recording levels down. While this function sounds very helpful, the circuit is always about a second behind “real life.” Using the AGC should be avoided in most analog recording situations.

The AGC circuit works quite well when it is part of a digital camcorder, whether consumer or professional. Because the AGC circuit used with digital camera recording technology operates much faster than with analog technology, the undesired tape hiss is not recorded. Therefore, disengaging the AGC circuit on a digital camcorder is not always necessary.