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WELCOME TO THE LITURGICAL MUSIC CORNER!

This portion of our semi-monthly newsletter will focus on various aspects of Musical Liturgy. In this month's newsletter, we will take a look at some audio techniques in regard to microphone usage, the equalization of sound, feedback reduction and elimination, and the placement of main loudspeakers and monitors.

DYNAMIC VERSUS CONDENSER MICROPHONES

There are two types of microphones that are commonly used as part of the audio system within many churches – they are the *dynamic* and the *condenser*. Each type of microphone has its advantages and disadvantages – because of these limitations, they are used for different amplification tasks since one type of microphone can serve particular applications better than the other.

DYNAMIC MICROPHONES

Dynamic microphones are one of the most used types since they are relatively inexpensive, widely available, contain high quality sound pickup, and are built with durability and high sound pressure levels (SPL) in mind. Some of the applications for which they are used to individually capture sound are: solo vocals, acoustic guitars, electric and bass guitar amplifiers, pianos, wind and string instruments, drums, and percussion. Unlike condenser microphones, they need no external power source. A few of the most common series and brands are the "SM" and "Beta" series by Shure, the "E" series by Sennheiser, the "D" and "P" series by AKG, the N/D series by Electro-Voice, and so forth. The average frequency response of these microphone types is usually between 50 Hertz (Hz) to 15,000Hz. In addition, they are commonly known for having a *unidirectional* pickup pattern.

CONDENSER MICROPHONES

Condenser microphones are used when a particular application calls for the capture of many sound sources where individual microphones are impractical to obtain. One such application is the use of overhead condensers to amplify a group of vocalists in a choir. They are also commonly used at the ambo since the one speaking does not need to be extremely close nor centered in order for it to pick up their voice. The ability of this type of microphone to amplify sound sources from a distance or in groups is due to its *omnidirectional* pickup pattern. Unlike dynamic microphones, condensers need an external power source for their operation – this source can come in the form of a battery pack or via the 48-volt "phantom power" feature that is standard in all analog and digital mixing boards. Its average frequency response is

usually between 30Hz to 18,000Hz or wider. Applications for which they can be used are: solo vocals, group vocals, medium to large choirs, pianos, guitars, percussion, and groups of instruments. In addition, because of the intricate electronics found within, condenser microphones sometimes do not have the same durability or high SPL handling as dynamic microphones. A few of the most common series and brands are the "Beta" series by Shure, the "E" series by Sennheiser, the "C" series by AKG, the "AT" series by Audio Technica, and so forth. Small microphones that hang over a choir area as well as the thin ones that are mounted on an ambo are usually condensers. The same is true for installable pickups that are specific for pianos, acoustic guitars, harps, and other instruments.

MICROPHONE PICKUP PATTERNS

Within every microphone is what is known as a *pickup pattern*, which is the way that it captures the sound from its audio source. Knowing this information is crucial so that the correct microphones are selected and used.

UNIDIRECTIONAL

Microphones that are designed to be *unidirectional* contain a pickup pattern that captures its sound source from the front and limited sides of the *capsule*, which is the internal part that picks up sound via the *diaphragm*. In regard to side pickup, unidirectional microphones are able to somewhat capture sources that are to the left or right of the capsule. Any sound that exceeds their design specifications for side pickup can still be captured but may not be as clear versus sound that enters the capsule closer to the front center. In addition, these types of microphones perform better when the sound source is as close, or somewhat as close as possible, to the capsule. Click **here** to learn more about unidirectional microphones, their pickup patterns, and their applications for sound amplification.

OMNIDIRECTIONAL

Microphones that are designated as *omnidirectional* feature a pickup pattern that captures its sound source from all directions around the capsule whether front, back, or sides. There are also variants of this omnidirectionality that are able to serve various sound pickup needs. Click **here** to learn more about these types of microphones, the variations of their pickup patterns, and their applications for sound amplification.

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MICROPHONE PLACEMENT FOR VOCALS AND INSTRUMENTS

The way that microphones are selected and placed in the sanctuary as well as amongst the vocalists and instrumentalists will determine the overall clarity of audio within the worship space. Proper selection and placement with the assistance of effective mixing board techniques, equalization, and location of loudspeakers and monitors will result in quality sound.

There are many ways that can be employed when it comes to microphone placement at the sound source. Amidst all of them, there are some basic protocols that should be followed for the best possible capture of sound. Click **here** for access to an article that covers basic microphone techniques. It was written as a general article for various houses of worship – as you read through it while maintaining a sense of Catholicity, substitute "pastor" as *priest* or *deacon*, "stage" as *sanctuary* or *music area*, and "praise band" as *music ministry* or *choir*.

EQUALIZATION (EQ): PARAMETRIC AND GRAPHIC

The mixing board is not just for adjusting the volumes of each inputted sound source – it is also used as a means in bringing forth sonic clarity from each individual source and as an assistant in reducing and eliminating microphone feedback. When used effectively, a combination of quality sound and feedback reduction can be achieved.

PARAMETRIC EQUALIZER

A *parametric equalizer* consists of low, mid, and high frequency adjustment controls that can be found above the volume control, whether rotary or vertical (*fader*), of an individual mixer channel. These three controls adjust the tonal "parameters" of the channel. Some mixing boards have what is known as a "mid sweep" selector, in that various midrange frequencies from around 250Hz to 4kHz can be selected then boosted or cut using the "mid" EQ control. When used effectively, mid sweep can be of great assistance in quelling feedback by selecting and cutting the offending frequency. It can also be used to shape the midrange to obtain more present or warmer tonal qualities.

GRAPHIC EQUALIZER

A *graphic equalizer* consists of five or more vertical sliders with a maximum of thirty-one within many professional models. The sliders are next to each other and boost or cut various frequencies which are arranged as a frequency "graph" from the lowest on the left to the highest on the right. Unlike its parametric counterpart which adjusts *individual* channels, a graphic equalizer adjusts the *overall* sound as it comes out of the mixing board's outputs before it goes into the system's amplifier.

HOW TO USE EACH TYPE OF EQUALIZER

For more specific information that pertains to the usage of each equalizer, click **here**. There are additional terms and concepts as well as advice on obtaining the highest quality audio via both types of equalizers. In addition, click **here** to view a chart that shows the frequency range of the human voice and various instruments.

WHAT IS FEEDBACK?

If one were to take a mirror then place another one in front of it with both mirrors facing each other, the result would be a continuous reflection that goes on forever. *Acoustic feedback* is the same concept but applies to amplified sound. If a microphone's volume is too loud, the sound that it is capturing comes out of the main speakers then gets recaptured by that same microphone. The result is a "reflection," just as with the mirrors, in that the sound forms a continuous "loop" which results in rumbling, ringing, howling, or squealing. Feedback is not only detrimental to the aural health of those who are present but can also damage the speakers over time especially if it occurs often.

There are many ways to reduce and ultimately eliminate feedback. Click **here** for some tips and advice on how to quell this particular sonic annoyance. In addition to making sure that none of the microphones are pointed directly at the main loudspeakers or monitors nor are too close to them, the article also covers the basic use of equalization as a way to suppress any feedback problems before they become worse.

PLACEMENT OF MAIN SPEAKERS AND MONITORS

In most cases, a professional audio company will take care of all sound system installations including the proper placement of speakers within a worship space. However, there may be times when it might not be possible to employ a professional-level company, thus resulting in the installation process being accomplished by those who do not regularly render this type of service. If so, it is imperative that basic concepts of proper speaker placement be understood and applied.

There are also many aspects in regard to the selection of main speakers, amplifier types, and how much audio power is needed to effectively fill an entire worship space with sound. Because every space is different and unique, the vast information regarding speaker selection and audio power determination is beyond the scope of this article. For advice in making the most effective and practical selections, contact the Office for Divine Worship using the information at the end.

MAIN SPEAKERS

For maximum sonic clarity, all main speakers should be mounted at least ten feet above the floor so that they can project their sound over the heads of all present, especially when they are standing up. If the worship space has a low ceiling, the speakers can be mounted on that ceiling in front of the sanctuary with their front grilles facing the people and angled slightly downward. They can also be mounted on the left and right walls, in front of the sanctuary, with a slightly downward angle and with their front grilles facing the gathered faithful. If additional "satellite" speakers are used toward the back for improved sound coverage in conjunction with the main front ones, they should be synchronized through a *digital delay* device – this ensures that they will sound off (*fire*) in synchronization with the main speakers so as to avoid echo from one set of speakers to the next. This type of *time correction* delay is built into most digital mixers as well as into "smart" amplifiers. If the setup has neither a digital mixer nor a smart amp, an outboard digital delay device would be needed. Regardless of where the mains are installed, they should be a considerable distance from both the sanctuary and music area so that feedback can be avoided. No microphones should ever point directly at either the main or satellite speakers.

Of all the various ways that speakers can be mounted, one of three most effective options can be employed. At St. Mariana de Paredes Church in Pico Rivera, there are multiple main speakers on the left and right sides of the nave, mounted on the ceiling, digitally delayed, and angled downward toward the people. At St. Pancratius Church in Lakewood, a small *line array* hangs from the front center of the ceiling along with delayed *sidefill* satellite speakers on the left and right for better front pew coverage. And at Ascension of the Lord Church in La Place, Louisiana, small column speakers that contain a strong *throw distance* are mounted high up on pillars rather than from the ceiling.

Within each of the photos in which the speakers are circled in yellow, be sure to observe their distances in relation to the sanctuary and music areas. They are decently far enough from both of those areas so that feedback can be avoided as much as possible.

MONITORS

As mentioned in this article that pertains to basic microphone techniques, the preferred type of microphone to use, if there is a monitor speaker (*floor wedge*) below it, would be a *unidirectional cardioid*. In addition, there should be a decent amount of space between the floor wedge and all front-line microphones – this is the first defense against feedback along with proper equalization. Within the music area at St. Mariana de Paredes Church, there are a couple of configurations that require different

monitor setups – one is for the Parish Choir and the other is for the small Mariachi ensemble. In regard to the Parish Choir, one monitor faces the vocalists so that they can electronically blend and hear each other, while the other one faces the Director of Music at the piano as a reference of the overall mix that is heard by the people. And regarding the Mariachi ensemble, both monitors face them so that they can blend each of their voices along with their instruments. In the photos, observe the distance from the microphones to the monitors – they are close to one another but still maintain decent space in between. Just as with the main speakers, no microphones should ever point directly at the monitors.

FINAL THOUGHTS

Amidst all of the technical aspects regarding the production of quality audio, it should be noted that the primary goal is to bring forth an adequate volume so that both the spoken and sung word can be heard clearly by all, but never to the point where extreme loudness becomes the norm. As stated in *Sing to the Lord: Music in Catholic Worship* (STTL), the acoustics of a church or chapel should be resonant so that there is no need for excessive amplification of musical sound in order to fill the space and support the assembly's song (*STTL*, no. 104). Each member of the assembly should be able to sense their voice joined to the music ministers and the entire community in a swell of collective sound (*STTL*, no. 102). In other words, the music ministry should never overpower or drown out the assembly, but rather, be joined as one voice to each other. The audio within a worship space is present to support the gathered faithful in their full, active, and conscious participation.

And finally, when investing in audio equipment, it is recommended to investigate the highest quality options that will not strain the financial resources of the parish. With that in mind, the most expensive options are not always the best ones. In many situations, it is not so much about the elevated status or newness of the individual components – more importantly, it is all about how well and how efficiently the equipment is used. Older pieces of gear can still be as effective as the newest and latest ones when utilized properly. Instead of desiring to purchase the most high-end components, take a close look at what is really needed to sonically benefit the worship space. The practical needs will always take precedence over component status because ultimately, the audio system will be used for effective sound coverage regardless of price point.

(Continued on next page.)

For additional information and consultation regarding audio within the Liturgy, please contact Victor A. Wheeler, Coordinator of Sacred Music Formation. He is also a former audio engineer who has mixed sound for various small to large music events through the years and can be reached at (213) 637-7054. You can also send him an e-mail at: vwheeler@la-archdiocese.org.

The next article within the upcoming newsletter will cover analog and digital mixing consoles. Based on the pros and cons of each type of console, which one is best for the audio needs of your parish community's church? We will take an in-depth look at the various possibilities.