

How loud is LOUD!

There is a lot of debate about the loudness of sound in some churches. It is a discussion that will never go away so we keep writing about it. When I give an opinion about something I know a lot about, I will also look it up and recheck the facts before I shoot from the hips.

Some say the sound in church is too high, some say it is causing hearing loss and so on.

Consider this, in some churches where they are singing acapella, I have measured 95 to 105dB* from a calibrated hanging mic 20 ft over the audience. That is seriously loud singing and worshipping. Some would say that is loud enough to be causing hearing damage. This is interesting because when a person is singing, they are hearing themselves even louder than what we measure at a distance.



If you are yelling or singing your heart out and at 3 feet you are measuring your SPL (sound pressure level) at 95dB, chances are you hear yourself about 10 to 15dB louder at your ear in the mid to low frequencies. That makes the sound to be 105 to 110dB. According to OSHA (Occupational Safety and Health)** noise exposure at those levels are limited to 30 minutes per day or less. That means singing in the shower is damaging your hearing – or is it? Does this make every professional singer who works nightly exposed to sound levels that exceeds OSHA standards a hearing loss victim? What about that guy on TV who shattered glass with his voice – shouldn't he be deaf? At those levels almost every professional entertainer should be deaf by the time they are 60 years old because of Noise Induced Hearing Loss. However, that is not the case.



People with some kind of hearing loss on average represent up to 30% of a population. (A statistic that has remained constant since the 1950's. Some hearing impaired associations have been quoting 25%.) Now *hearing loss*, *hearing impaired* and the *hearing disabled* is a wide range of hearing loss we can measure. As an overly simplified guideline we can safely say the following. Hearing loss is when a person has up to 25dB loss of hearing in one or both ears. People who are hearing impaired (which is a hearing loss of 35dB or more in one ear) and need assistive hearing aids are about 10% of the 25% group. Deaf people are about 0.5 to 1.5% of the

same group. The rest of the people living with hearing loss and are fully functional without assistance is about 13.5%. Within the 25% group, noise induced hearing loss is about 5 to 7%. Health, illness, chemicals, smoking, injury, genetics and other causes make up the other 15 to 20% of overall population hearing losses.

When you do research on the numbers, the results are interesting. In the 90's they tested two orchestras and found that 43% of the performers had some sort of hearing loss that was considered higher than the average. (Based on assessment numbers from the early 50's apparently.) More recently they tested office workers for hearing loss and they found that 44% of the people had above average hearing loss for their age. For those who

made it to 70 years of age, the number of people needing hearing aids was the same in both groups and about the national average of the general public. Similar numbers show up for construction workers. So what does this mean?



When you look at the numbers, should we be alarmed or just cautious? For those who sound the alarm they should know the facts. When you look at the overall numbers, things haven't changed much in the last 50 years. Education, easier access and affordability makes the awareness of hearing loss appear that there are more people with hearing loss. The fact is, the average person's hearing is better today than in the early 60's. "For men and women of a specific age, high-frequency hearing thresholds were lower (better) in 1999-2004 than in 1959-1962. The prevalence of hearing

impairment were also lower in the recent survey. Differences seen at 500 Hz may be attributable at least in part to changes in standards for ambient noise in audiometry. The National Health and Nutrition Examination Survey 1999-2004." Hoffman HJ, Dobie RA, Ko CW, Themann CL, Murphy WJ. Ear Hear. 2010 Dec;31 (6):725-34. doi: 10.1097/AUD.0b013e3181e9770e. (Note: this 1999-2004 study was started 20 years after the Sony Walkman/portable music players with earbuds or headset were first introduced in 1979.)

What has changed is the old adage of deaf and dumb. That is no longer a stigma for most of our population groups. More and more people who used to hide their hearing problems are coming out and declaring their hearing loss. For others, hearing aids have become so small that you can't see them. So while there is a current surge of hearing aids being sold and the fact that some people who are buying hearing aids (who don't actually need them,) doesn't mean that there is an increase in Noise Induced Hearing Loss. So why am I mentioning this?



We need to keep the joy and community in our churches and worship centers. Singing brings people together and the quality of worship matters. Especially if you care about people attending church more than once a month or once a year or to win over un-churched people. (Un-churched people are greatly influenced by their first impression of the worship experience and not by the looks of a building. If the sound is not what they are accustomed to, what are the chances for a return visit if the sound is distorted and they can't understand the minister?)

Loudness of worship services has two elements. There is *amplified sound* and *non-amplified sound* or what I call Natural Sound. When a congregation is singing along with or without any acoustical instruments at 100dB, all of that sound is natural and undistorted. The ear has a natural defense mechanism (A muscle in the ear that needs to be exercised regularly it seems) that helps to protect the ear - otherwise every opera singer over 55 years of age would be deaf.

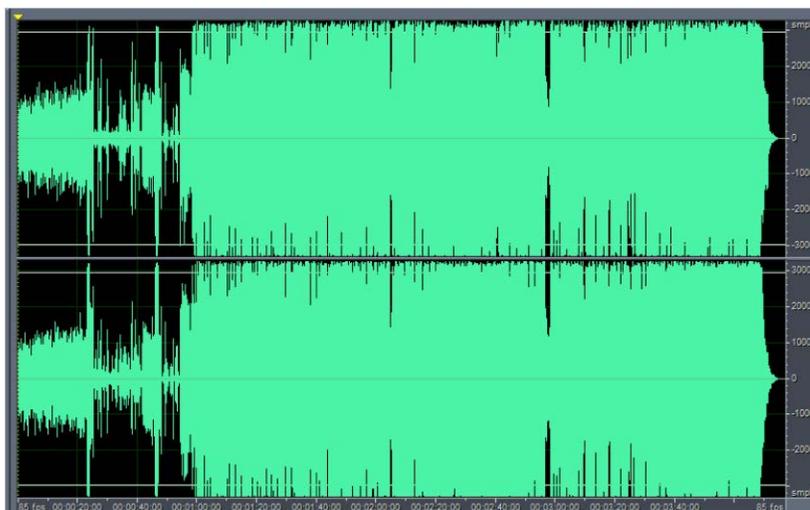
When the sounds at those levels are amplified through a sound system, often there is a high level of distortion due to the fact that many sound reinforcement systems at all price ranges are under powered, under-designed or adjusted improperly and most of them are in rooms that limits their performance regardless of the quality of the sound system (microphones clipping and overloading the mix also contributes to distortion. Room problems often lead to running a mixer in this way.) When distortion is as little as 1%, it is audible and the average person can

hear it – especially in the 1000 Hertz range. At 1.5% of distortion you can perceive the sound to be 5 to 10 dB louder than what it is. The more distortion, the louder the music or speech will seem at lower sound levels. In churches where I was able to measure distortion and the amplifiers were running at 50% of their useable power, there was 5% distortion. That is a nasty sounding system. (In that church the acoustics were inducing the sound system to distort.) Here is an example; at a 3500 seat church I was visiting, the sound system seemed very loud. I pulled out my SPL meter and measured 85dB and knowing what to listen for, you could hear distortion in the amplified sound – mostly in the vocals. At another church where the sound didn't seem loud enough, or it could be performing at a louder level comfortably, I was measuring 100dB. The cleaner the sound, the louder you can listen to it without finding the loudness offensive and many people will comment on their enjoyment of the worship service experience.



Remember that there is a difference between musical distortion created by a musical instrument such as an electric guitar and mechanical distortion. Musical distortion is a desirable sound. Musical distortion is applied to all frequencies uniformly which makes it non offensive. When a loudspeaker is under powered or driven past its limits, it most often creates mechanical distortions. That distortion usually boosts the sound around the 1K area or between 800 to 1200 hertz. If you try to EQ it out and then turn the levels back up, the distortion comes back and its range of distortion gets wider. So you try to apply more EQing but the sound quality of the sound system starts to spiral downhill. The only way to get control back is to turn the sound system down but turn the bass up if you have separate sub control (unless your subs are under powered or driven past their limits.)

The reaction of the ear to distortion has two issues. With excessive energy at 1K the natural protection system of the ear doesn't work as well and mechanical distortion could damage your hearing. Excessive distortion also causes the listener to be irritated and often the annoyed person will tune out of the singing or listening to the sermon. (Some people just stop participating all together and this can lead to people not attending church.) The overall perception of distorted sound is that it is too loud when it is not. Sound systems should be designed and adjusted with the lowest possible level of distortion. Church sound systems with praise and worship teams leading should be designed to perform at 105dB because the audience can sing that loud if the worship spaces allows it. Does that make it a Rock and Roll system? No because most Rock and Roll/concert systems are designed for an evening of an emotional blast in spaces that sounds bad and if you test them for distortion, they are often driven into the 2 to 5% range. Many concert systems are designed to re-



scramble the eggs you ate for breakfast 12 hours earlier. Church sound systems have to be better and cleaner sounding – especially for speech.

Question is, does every church sound system have to keep up to such standards? Yes and No. Yes, if the praise and worship team is leading the worship and if they are performing at the same volume levels as the congregational singing. No, if the worship team is accepting of the audience routinely



drowning them out if the Worship team and leadership can accept that as normal. It also means that the performers have to be confident enough to keep performing when they can't hear themselves. (A skill that is learned with lots of practice and determination to allow the congregation to be the center of attention...) (It is a fine line between leading worship and controlling worship.)

In the end if the sound has audible distortion, yes, you may very well be turning people off and long exposure to distorted sound could be damaging over time. You could avoid the distortion by not running the sound system as loud to keep the sound clean and look for ways to improve the sound system and the room acoustics through fund raising events or special donations. On the other hand if the sound is all natural and clean, enjoy the worship and celebration as loud as the people are singing. There is no harm doing something that we normally do without technology. After all, seven times it says in the Bible to make a Joyful noise unto the Lord. Let's not hold back and limit ourselves. Since God wants us to enjoy our time with Him, let's do it!

* Note: All measurements are flat. Since sound pressure on the ear is at all frequencies, we have to look at unweighted measurements when considering measurements for hearing damage. The alternative scale is "C" weighted or "dBC".

** Note: OSHA uses the "dBA" which gives a lower number because it mainly looks at how sound is perceived in loudness. It does not give accurate noise exposure levels and actual sound pressure levels on the ear. Bass frequencies, which is where most of all the energy is, is what masks the highs when we start to lose our hearing.

Photos are courtesy of JdB Sound Acoustics and from various internet websites.

By Joseph De Buglio

A church sound system and acoustical consultant, teacher, author and church building designer.

For more information about church sound and acoustics, contact Joseph De Buglio at jdb@jdbsound.com or www.jdbsound.com