

Understanding Sound Systems and Acoustics for Jazz It's Not Rock and Roll!

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What This Class is Mostly About

- **How sound behaves in places where jazz is played**
- **How to work with the natural acoustics of a place to make your music sound good**
- **How sound systems work (at bit)**
- **How to work with a sound system to make your music sound good**
- **What kinds of places work for jazz?**
- **What kind of places don't work for jazz?**

What This Class is Mostly About

- **Big bands (12-18 pieces)**
- **Small bands (7-10 pieces)**
 - Like a small big band
- **Small Groups (2-7 pieces)**
 - High energy bop and post bop
 - Soloist (including singers) with rhythm section
 - Piano and/or guitar trios
 - Trad forms
 - Chamber jazz
 - “Free” forms
- **Unaccompanied soloists (piano, guitar)**

Jazz Sound Reinforcement

- **Reinforcement means using just enough amplification to provide natural sound and good musical balance**
- **Less is more!**
- **Most jazz performances are overamplified**
- **Real instruments sound much better than even the best sound systems**

Jazz Sound Reinforcement

- **The audience should hear everything going on in the band**
- **The audience should not notice the sound system**
- **“A bunch of guys in a room playing”**

Jazz Performance Venues

- **Small rooms (100 – 250 seats)**
 - Night clubs, small theaters
 - Reinforce solos and quiet instruments only
 - On-stage leakage may be a problem
- **Medium size rooms (250 – 750 seats)**
 - Larger clubs, most theaters
 - Reinforce solos and quiet instruments only
- **Concert Halls**
 - Approach with great care
- **Very large rooms and outdoors**
 - Reinforce everything, with great care

Jazz Doesn't Need Much Help!

- **Quieter instruments**
 - Piano, vibes
 - Bass
 - French horn, tuba, flute
- **Soloists**
 - Horns
 - Singers
- **Most venues need limited (but good) stage monitors**
- **Less is more!**

Jazz Doesn't Need Much Help!

- **In small rooms, the band is almost always loud enough, but quiet instruments and soloists need some reinforcement for good balance**
- **In medium-sized rooms, the band is often loud enough, but quiet instruments and soloists need some reinforcement for good balance**
- **In most large rooms and outdoors, every instrument needs reinforcement**



Let's Get Real

- Do you really believe that this \$500 box can sound as good as the \$20,000 collection of instruments in your quintet (or \$50,000 in your big band)?



Let's Get Real

- Do you really believe that this \$500 box can sound as good as the \$20,000 collection of instruments in your quintet (or \$50,000 in your big band)?
- If you do, I want some of what you're smoking!



Let's Get Real

- What it can do acceptably is reinforce solos and the quieter instruments at levels that balance with an unamplified band
- **LESS IS MORE!**

Less is More

- Start with no amplification, and amplify only those instruments that aren't loud enough for good musical balance (and presence)
 - Piano, vibes, bass, singers, horn solos
- Use stage monitors as little as possible
 - Singers
 - Upstage so the rhythm section can hear horns

Thad Jones/Mel Lewis in 1,000 seat theater, c.a. 1970 No reinforcement, mics are for recording



**Thad/Mel ca 1970 in 700 seat theater
No reinforcement
(mics for recording)**



Key Elements of Good Jazz Sound

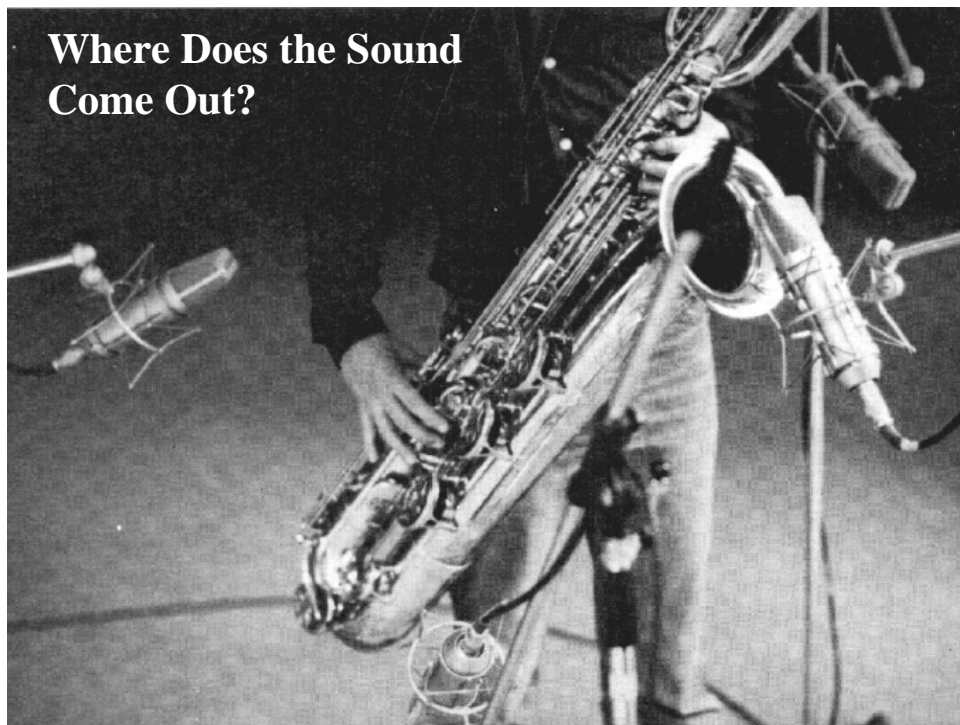
- **The right mic in the right place**
- **Amplify only what you need for good balance**
- **Use the best loudspeaker system you can afford**
- **Mix gently to preserve musical dynamics**
- **Use a stage setup that minimizes the use of stage monitors**

Microphones and Mic Technique

- **Nearly all popular mics are directional**
- **Use mic directivity to pick up your instrument and reject others**

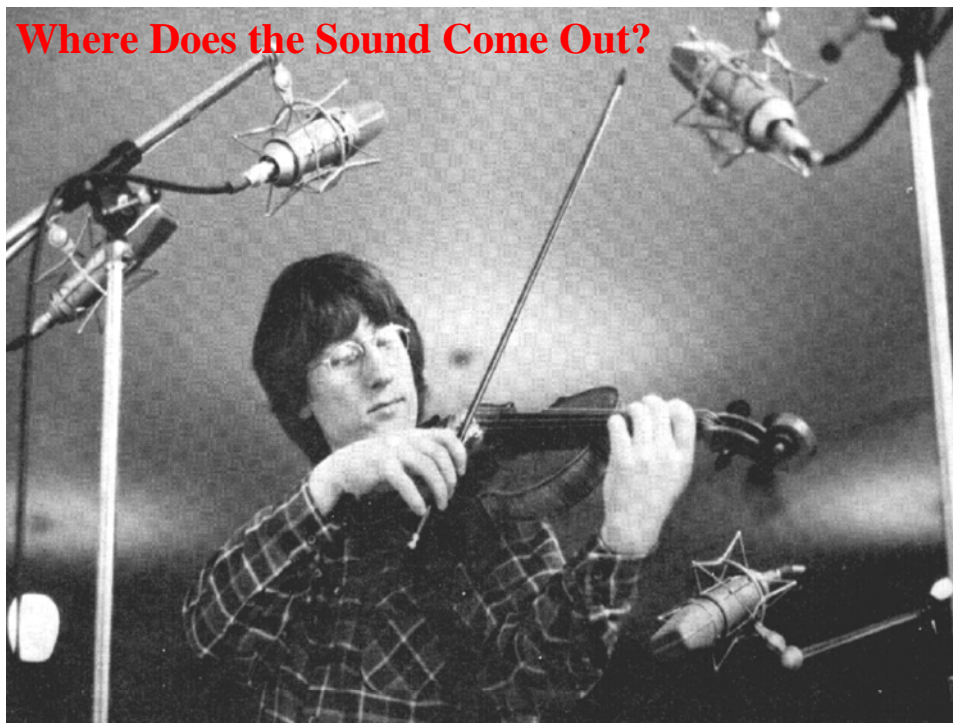


Where Does the Sound Come Out?





Recommended 2-mic Setup



Where Does the Sound Come Out?

- **Saxophone**
 - The bell – highs and presence
 - The holes – lows, mids
 - The side of the horn – lows, mids
- **Violin, bass – broadside to the body**
- **Piano – all over the instrument, focused by the lid to the audience (and the band)**

Where Does the Sound Come Out?

- **Miking the bell “totally misses the lower partials which radiate almost exclusively through the open tone holes on the walls of the conical tube. A mic placed at the bell picks up an exaggerated amount of higher frequency components and lacks the fullness of the low frequency energy to balance the spectrum.”**

The Right Mic in the Right Place

- **Mic placement is a compromise between getting the best sound from your instrument and picking up “wild” sound from the rest of the band**
- **That “wild sound” is called “leakage”**
- **Leakage makes the overall sound of the band muddy, and it makes loud instruments even louder**

The Right Mic in the Right Place

- **Reeds and brass**
 - **Not too close (at least 6 inches)**
 - **NEVER MIC THE BELL OF A HORN!**
- **Piano**
 - **Two mics, an inch or so above the hammers**
- **Vibes**
 - **Two mics, high enough to be clear of mallets**

**Clarinet and
soprano sax**



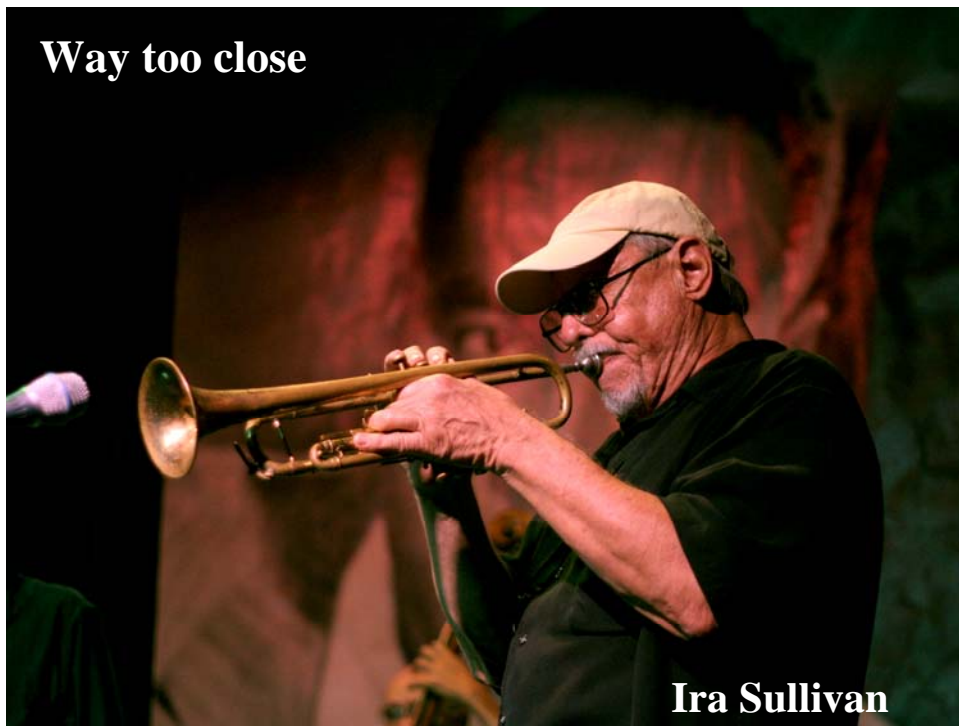
Eric Schneider

Way too close



Ira Sullivan

Way too close



**Alto, tenor, and
baritone sax**



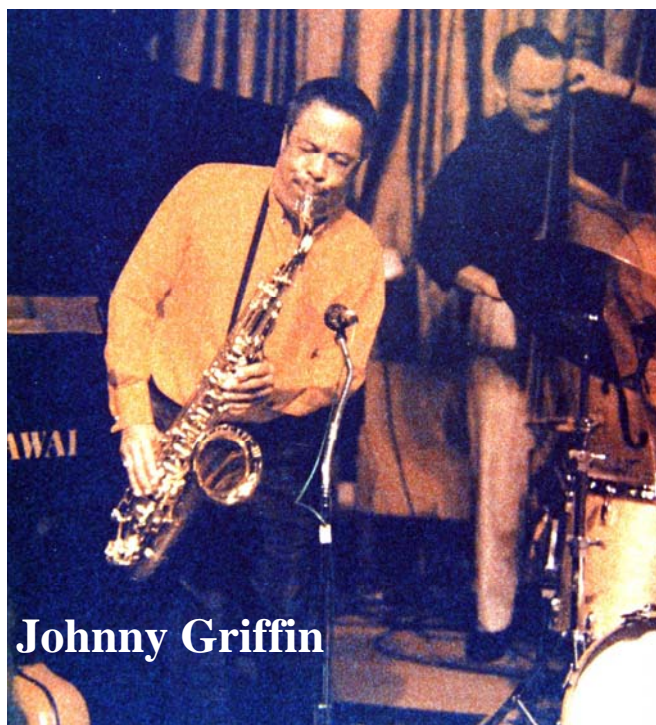
Bobby Hutcherson - vibes



Harold Land

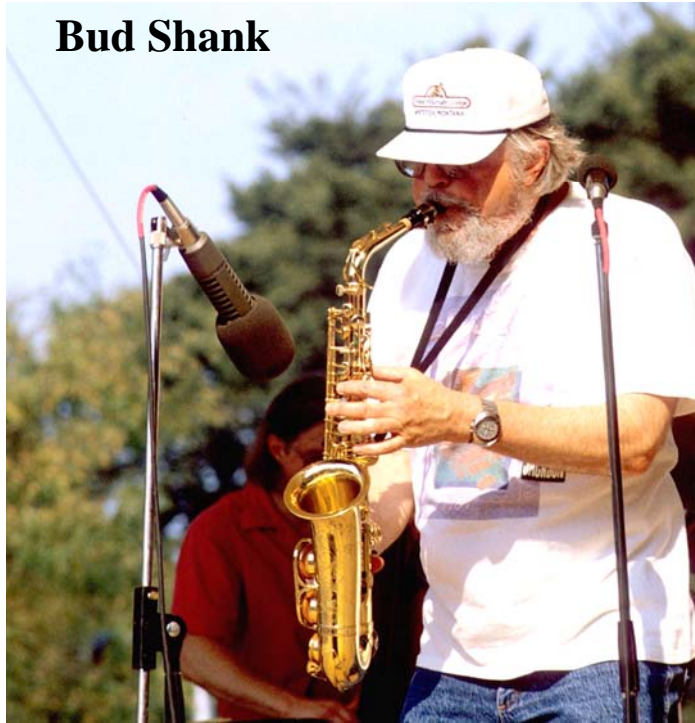


Tim Hagens



Johnny Griffin

Bud Shank



**Give yourself
room to move**

**Oops – the
mic should
have been
higher!**





**Maria Schneider Orchestra
at Monterey**



Great Mic Technique



Mark Murphy

Great Mic Technique



Avoid “rock-and-roll-isms” that separate you from your audience.

Don’t cover your face with the mic – it’s really bad show biz! Your audience wants to see you too!

Build your voice so you can work the mic at a distance.



Microphone Types

- **Condenser mics**
 - Need small amount of power to operate
 - Usually supplied by the mixer, but some older PA systems may not have it (hotel lounges, etc.)
 - Best for percussive instruments like piano, drums
 - Can be overloaded by very loud sounds
- **Dynamic microphones**
 - SM58, RE16, RE20
 - No power required
 - Impossible to overload

Proximity Effect

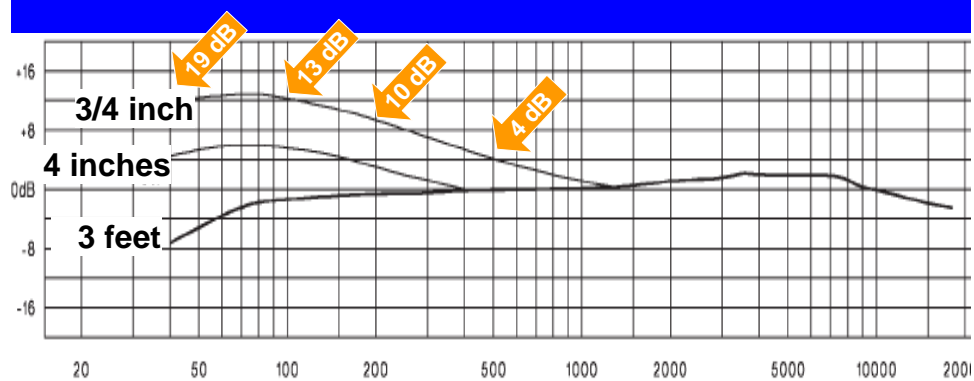
- **Extreme bass boost that occurs when a mic is very close to a sound source**
- **Destroys the sound of trombone and other low pitched horns by making them very muddy**
- **Adds low octaves to a muted trumpet**
 - Maybe that's what you want – or maybe not?
- **Emphasizes breath pops**
- **Adds a harsh “breathy” sound to flute and emphasizes lower octaves**

Proximity Effect

- Occurs with all directional mics (except a few specially designed to correct it)
- Omnidirectional mics don't have this problem
- Can be used as a creative tool
 - Maybe you want that extra low end for a musical purpose

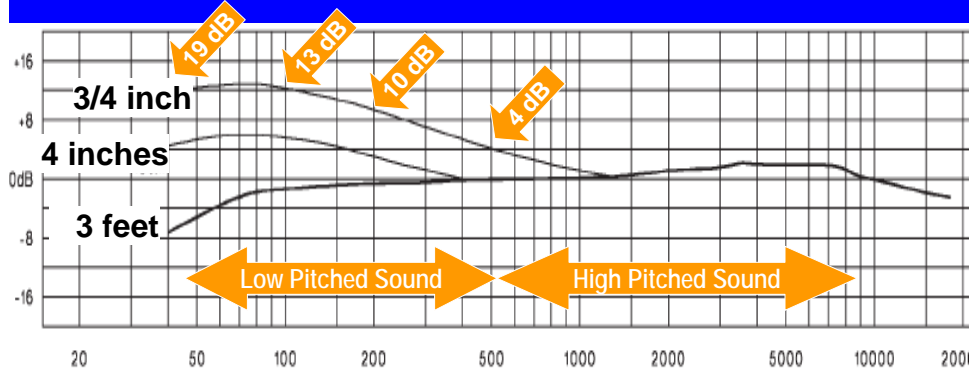
Proximity Effect in a Typical Cardioid

(from a mic data sheet)



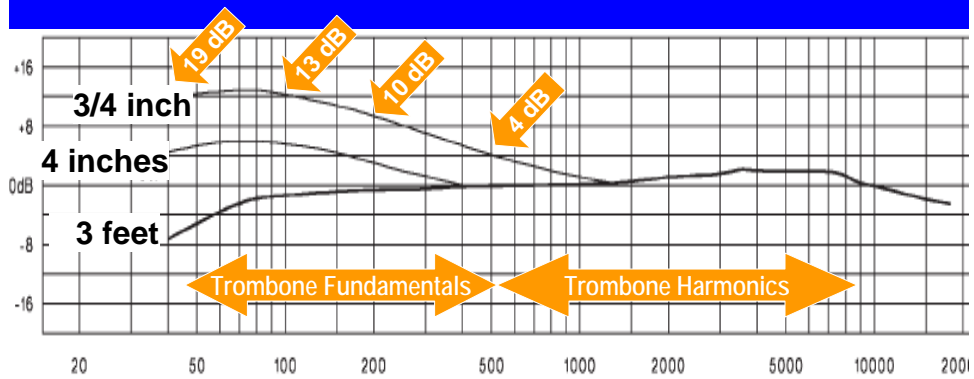
Proximity Effect in a Typical Cardioid

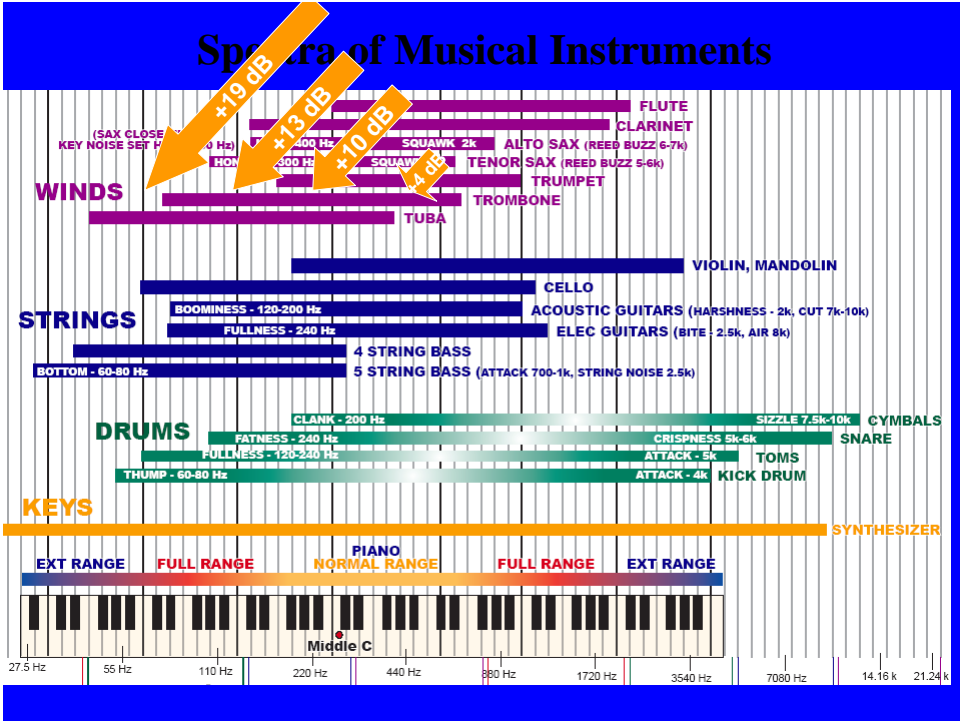
(from a mic data sheet)



Proximity Effect in a Typical Cardioid

(from a mic data sheet)





Variable-D Microphones



Variable-D Mics

- Designed to eliminate proximity effect
- Extra sound entry slots along the barrel of the mic do the trick
- All are dynamic mics
 - Electro-Voice RE16, RE20, RE27
 - EV 666, RE10, RE11, RE15, RE18 (discontinued)
 - Shure SM53, SM54 (discontinued)
 - AKG D202E, D222E, D224E (discontinued)

Variable-D Microphones



Buy a Mic For Your Instrument

- **Most places you are likely to play will have only rock and roll mics**
- **Very few sound companies own “jazz” mics**
- **The right mic in the right place can make your instrument sound much better**

Some of My Favorite Jazz Mics

- **Emphasis is on performance and “moderate” price**
- **These mics are not cheap, but they last forever**
- **Mics are nearly indestructible, so look for them used**
 - **Exception – The Beyer M160 is a ribbon mic, and is rather delicate. Be careful buying used.**
- **Some trustworthy vendors for new mics**
 - **Full Compass**
 - **Sweetwater**

Some of My Favorite Mics

- **Trumpet**
 - Shure KSM44 set for omni-directional pickup
- **Trombone, French Horn, other low brass**
 - EV RE20, RE27
- **Saxophone**
 - EV RE20, RE27, Shure KSM-series
- **Piano (two required)**
 - Shure SM81, KSM-series, AKG C451B
 - Neumann KM84, KM184
- **Vibes (two required)**
 - Beyer M160

Some of My Favorite Mics

- **Bass – Mic to use on small boom stand**
 - EV RE20, RE27, Shure KSM-series
- **Bass – Wrapped in foam, upward in bridge**
 - AKG C451B, Neumann KM84, KM184, Shure KSM137
- **Vocals (Try on your voice before buying)**
 - Shure SM81 w/foamy, SM87, AKG C535
 - Neumann KMS105
 - EV RE16 (for voices with too much bass)
 - Beyer M160 w/foamy (mellows out a harsh voice)

Windscreens (Pop Filters)

- **Very important for vocal mics**
 - Foam generally sounds smoother than metal screens
 - Important for some singers with cardioid mics
 - Breath noise with close miked flute

A Mellow Ribbon Mic for Vocals and Vibes



**AKG W23
Windscreen**

M160

Side Address Mics

- Made by Shure, AKG, Neumann, Audio-Technica
- Most have switchable patterns
 - Omni
 - Cardioid
 - Bi-directional (figure 8)
- Logo side is the “front”
- Very good mics, but most are a lot more expensive

KSM44



Stage Setup Matters a Lot

- Set up on stage so that everyone can hear each other
- Use stage monitors only to fill in what you can't hear

**Kenton on tour with Wally Heider setup c.a. 1973
Only solos reinforced**



Stage Monitors – A Necessary Evil

- **Necessary because the essence of jazz is interactivity and group improvisation, so everyone needs to hear each other**
- **Necessary because singers (and some horn players) need to hear their own intonation**
- **Necessary because the acoustics of most jazz performance venues does not provide the required communication**

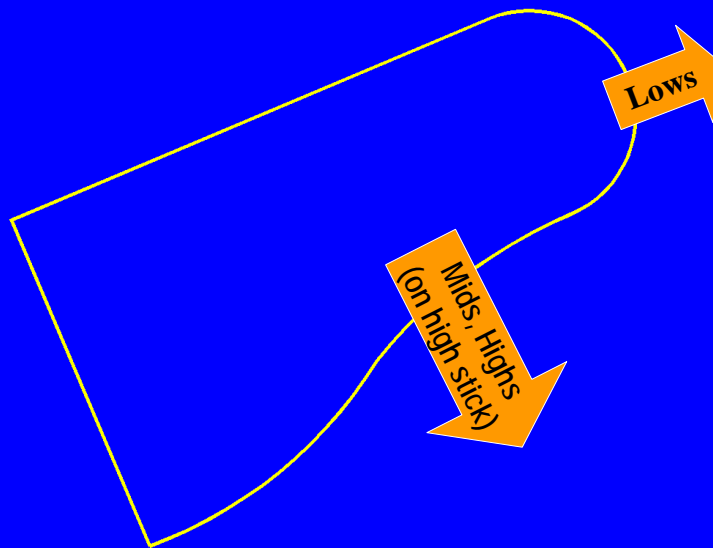
Stage Monitors – A Necessary Evil

- **Evil** because all the sound fed to the monitors bounces off the ceiling and walls and out into the audience
 - That bounced sound is late, and muddy
 - It makes sound in the audience echoey, muddy, and indistinct!
- **Evil** because monitors tend to cause loud players to play louder, and everyone plays louder to compensate
- **Louder is not better!**

Using Stage Monitors

- **Try to set up your band so that most can hear each other without monitors**
 - Set up closer together so you hear each other directly
 - Learn to balance naturally with each other (rhythm section not too loud)
- **Soloists need to hear the piano**
 - Set up with soloists just downstage of the piano and put the piano lid on a high stick

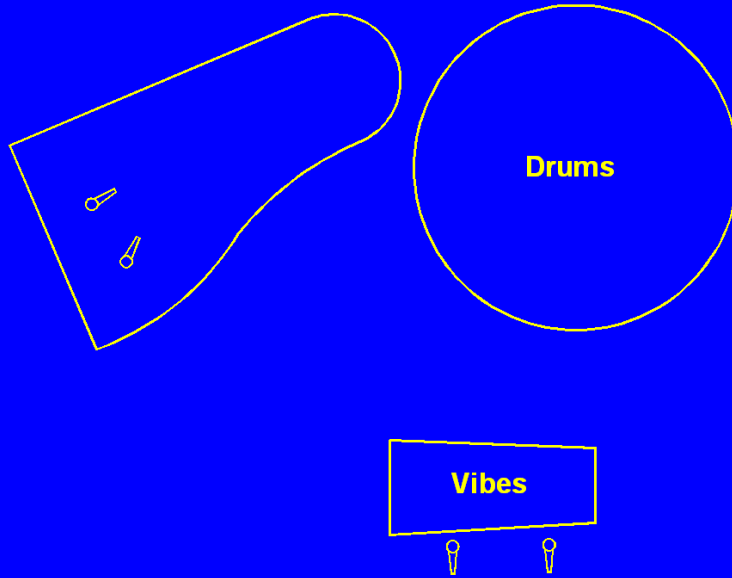
Piano Directivity



Stage Setups

- **Piano mics often pick up bass and drums**
 - Called “leakage”
- **Position bass amp and drums to minimize leakage into piano mics**

Stage Setups – Be Creative!



Stage Setups – Be Creative!



Using Stage Monitors

- **Rhythm section needs to hear soloists**
 - **Drums and bass are probably playing too loud**
 - **Learn to play less loud so you balance with the band**
 - **Don't worry about not being loud enough – it's easy for the sound operator to add a mic for you (or turn you up)**
 - **Pianist may need a monitor (maybe not if drums and bass aren't too loud)**

Using Stage Monitors

- **Use a “Hot Spot” monitor for pianist**
 - **On a stand at ear level**
 - **Minimal spill to the audience**
 - **Inexpensive**
 - **Use model with volume control**
- **<http://galaxyaudio.com>**



Using Stage Monitors

- **Never put horn sections in monitors**
- **Never put drums or bass in monitors**

An Alternative to Stage Monitors

- **A common sound system “rule” is to not set up speakers behind the band. The intent of this rule is to avoid feedback.**
- **In a small to medium-sized room, break the rule by setting up your PA speakers upstage (that is, behind you) on high stands.**
 - **Now, the main system works as a stage monitor**
 - **If you get feedback, you’re probably trying to run the system too loud!**

Using Stage Monitors

- Stage monitors are not indicative of what the audience hears!
- Stage monitors are there for you to hear the necessary musical content
- Don't waste everyone's time tweaking the sound of the monitors – just make sure you can hear
- The louder you make the monitors, the worse the sound is for the audience

Big Bands

- Use two mics on the piano, two on vibes
- Use mics for solos and vocals
- Use a mic on the bass, but don't turn it on if bass is already loud enough
- No mics on horn sections or drums except outdoors or in huge rooms (1,500 seats)
- Use a guitar mic only if no guitar amp (i.e., Freddie Green)

Monitors for Big Bands

- **Feed solo and vocal mics to the rhythm section**
- **Give the singer a stage monitor**
- **Stop there!**

Mixing Big Bands

- **Don't make solos "bigger than life"**
 - **Let the solo start at a natural level and build with the dynamics of the chart and what the soloist is playing**
 - **Carefully mix solo mics so that the solo is still there when the band soars around it**
 - **We want to hear what the sections are playing under and around the solos**
- **Turn down solo mics when no solo (but stay awake!)**

How did Crazy Loud Jazz Start?

- **Maynard Ferguson had some pop hits**
 - His record company hired a Rock PA crew
 - Shure gave him a zillion cheap mics
 - It made his band painfully loud
- **Miles, Herbie, and Gil Evans created a new kind of jazz/rock music that needed rock PA**
 - It was right for their bands
 - It is dead wrong for most jazz!

Musician Mistakes

- **Eating the Microphone**
 - Gets only part of the sound of the horn
 - Slight movements destroy dynamics
 - Slight movements change entire character of the instrument
 - Proximity effect makes horn muddy
 - In the bell makes saxes nasal and harsh
 - Gives snake charmer sound to soprano sax and clarinet
- **They actually teach this in textbooks!**

Musician Mistakes

- **Wandering on and off mic**
 - **Kills dynamics**
 - **Difficult for even a good sound operator to maintain balance**
 - **Mic picks up other instruments if operator has to turn it up (makes those instruments indistinct)**

Mixing

Mixing

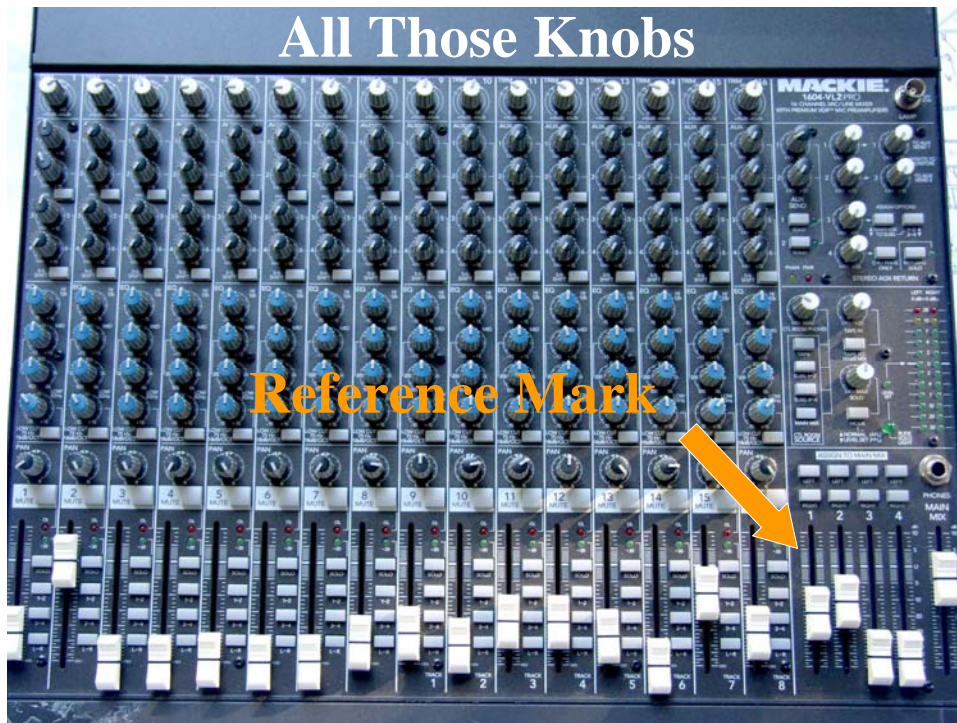
- **This is advice for your sound operator**

Zero-Based Mixing

- **Listen to the band with no amplification**
- **Add only what you don't hear enough of**
- **Leave bass and drums for last**
- **Get the balance of the melody instruments right first**
- **Get the piano right**
- **Keep up with soloists**
- **NOW add bass and drums if you still need it!**

Mixing Jazz

- Don't put a soloist way up on top!
- Jazz is an ensemble art, and a big part of that art is the sound of the sections playing behind the soloist
- A soloist should be just loud enough that he/she is still heard when the band roars behind them
- Stick with the mix. Jazz is dynamic, things change. Many players double on different instruments. Every tune can be very different.





← Gain Trim

Matches loudness of the microphone and instrument to the mixer. Prevents overload of the mixer by the microphone.

Set it so that channel fader is near the top of it's range when the mix is "right."

← **Overload Light**
Turn down the gain trim!

← Channel Faders

Do your mixing here.



Equalizer Controls

A very important control. Turn it down to reduce proximity effect and make the instrument (or voice) sound "right." For most vocal mics, halfway down is about right.

← Low Boost/Cut

There are almost no good reasons for turning this control up. It will make the sound muddy and is likely to cause feedback.



Equalizer Controls

This is a very important control. Use low cut on every mic except bass.

Low Cut



Equalizer Controls

Turn down to reduce harshness or excessive sibilance.

Rarely needs to be turned up.

High Boost/Cut



Equalizer Controls

Ignore the middle EQ controls.
They are mostly useful for
special effects and bad singers .



Mid-Range Boost/Cut

Use them sparingly in “cut”
mode to fix feedback.
Using them in “boost” mode
will likely cause feedback.



Equalizer Controls

A good jazz mixer will use
the low cut switch on
everything except bass,
and will use low rolloff on
several mics, and may use
some high cut on one or
two mics.

That’s all.

Less is more!

Some General Advice

- **Learn How your instrument sounds**
 - Move around someone else playing an instrument like yours and listen
 - Put one ear where you think a mic would work and listen to the instrument

Some General Advice

- **Most great players did not need mics to blend within a band or even solo over it**
 - Stan Getz
 - Gerry Mulligan
 - Dizzy Gillespie
- **Develop your voice on your instrument so that you are not depending on a sound system**
- **If you're playing acoustic bass, learn to play your instrument, not your amp**
 - Use your amp for special sounds and effects

Some General Advice

- Part of being a good jazz player is controlling the dynamics of what you're playing
- Most rhythm sections play way too loud!
 - Bassists crank their amps too high
 - Drummers play too loud on up and medium tempos, but too softly on ballads
 - A sound operator can't turn you down if you're playing too loud, but must make the rest of band too loud to balance with you

Some General Advice

- Don't count on sound operators helping you with dynamics or getting your sound right – you've got to do that on stage

Some General Advice

- Don't count on sound operators helping you with dynamics or getting your sound right – you've got to do that on stage
- Most sound operators aren't hip enough to do that.

Clues That the Sound Man Doesn't Have a Clue

- He shows up with nothing but SM58s
- He sticks a mic in the bell of your horn
- He uses any drum mics in a small room, or more than two in a big room
- He wants to use a pickup on your piano
- He only uses one mic on the piano
- He puts a mic in one of the piano holes
- He puts a mic under the piano

Musical Acoustics

Musical Acoustics

- **Sound bounces around rooms**
- **Sound is reflected by hard walls**
 - Wood, plaster, concrete
 - Wall acts like a mirror
- **Sound is absorbed by soft surfaces (gets weaker)**
 - Curtains, fabric, acoustic treatment
 - Surface acts like a sponge

Musical Acoustics

- **Sound travels much slower than light**
 - 790 miles/hour (at room temperature)
 - 1160 ft/sec
 - 200 ft in a half a beat at medium tempo
 - Basketball on a playground

Musical Acoustics

- **Sound loudness falls off as it bounces around a room**
 - Each bounce absorbs a bit of the energy
 - Hard surfaces reflect most of it
 - The air absorbs a bit of the highs
 - It takes time for all of this to happen
- **In most “good” big rooms, loudness drops off smoothly, and is random**
- **Smooth decay is called reverberation**

Musical Acoustics

- **Smooth decay is called reverberation**
- **Reverberation time**
 - **Time for the sound to decay by 60dB**
 - **1/1,000,000 of original loudness**
 - **1.5 – 2 seconds in a concert hall**
 - **4-7 seconds in a baroque church**
 - **Less than half a second for jazz**
- **Reverberation is longer and stronger in the lowest octaves**

Musical Acoustics

- **A hard wall behind the audience creates an echo back to the stage**
 - **Half a beat (or more) at medium tempo**
 - **Longer in larger halls**
 - **Echo will be stronger if that wall is curved**

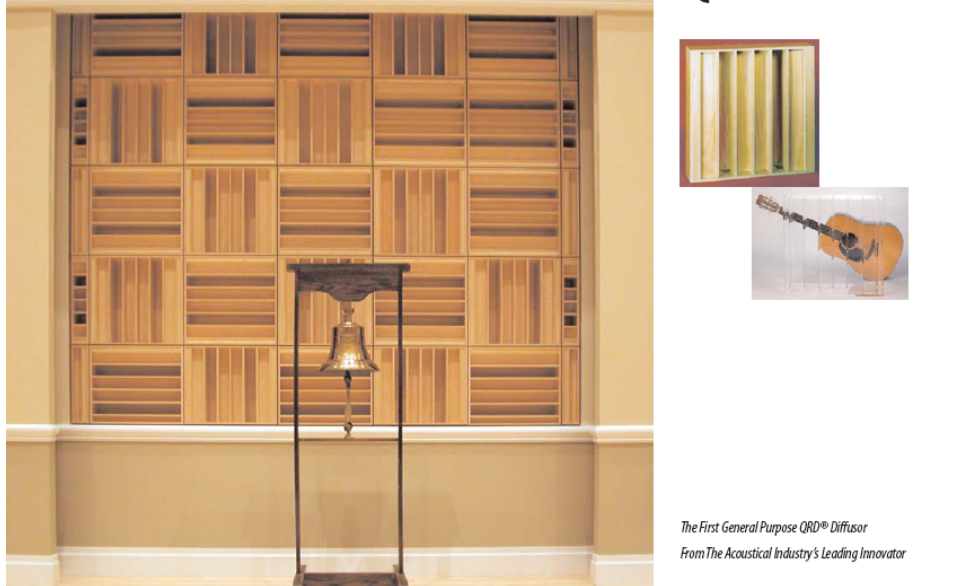
Inward Curved Surfaces (Concave)

- **Focus sound back to the center of the curve**
 - Often the stage
- **Focusing can make echoes very strong**
- **Any hard concave surface causes focusing**
 - Rear walls
 - Ceilings
 - Domes
- **In big rooms, echo is a beat or more behind**



**Curved Surfaces in A Modern Concert Hall
(Meyerhoff – Baltimore)**

Diffusors like this on an upstage wall help players in a big band hear each other better



Diffusors in a Rehearsal Room



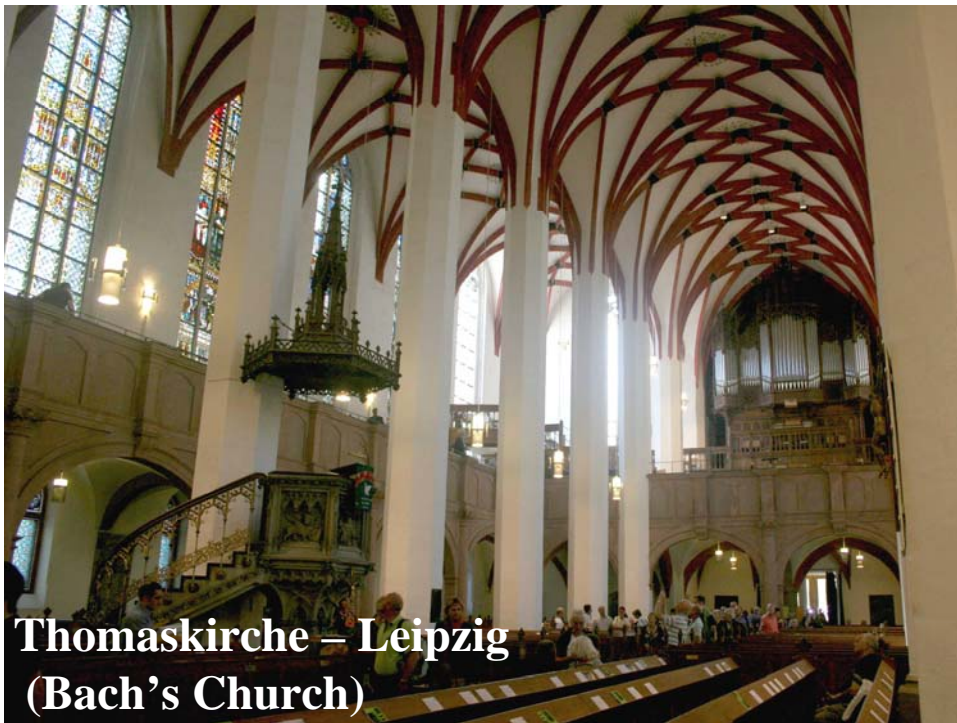
Outward Curved Surfaces

- **Diffuse the sound (spread it out)**
- **Prevent strong echoes**
- **Provide more random reverberation**

Musical Acoustics

- **Reverberation becomes part of the music**
 - **Each beat is held by the reverberation while the next notes are being played**
 - **Blends the harmonies and sounds of the orchestra**
 - **Enhances the harmonic content**
 - **Makes the orchestra louder**
- **Virtually all classical compositions depend on reverberation**

**Thomaskirche – Leipzig
(Bach's Church)**



**Thomaskirche – Leipzig
(Bach's Church)**

A Modern Concert Hall Berlin Philharmonic



Chicago Symphony Center



Acoustic Stage Monitors

- Musicians need to hear each other to play together
- Reflective surfaces bring sound back to the orchestra
- Acoustic “clouds” over the orchestra
- Hard side walls and rear walls of stage
- Ceiling is too far away
 - A late echo
 - Not strong enough

Jazz in Concert Halls

- Concert halls are too big!
- Long reverberation time
- Too much reverberation
- Reverberation smears everything together
- Bass lines all run together, muffles the beat
- Reflections back to the stage are too late
 - Half a beat (or more) behind
- Percussion and fast tempos get “eaten alive”

Composition for the Hall

- Ellington wrote for the musicians in his orchestra
- Bach wrote for the musicians who would play his music (mostly in Leipzig)
- Bach wrote differently for the acoustics of each place where his works would be performed
 - Weekly compositions for his church
 - Brandenburg Concerti
 - Large organ works

Composition for the Hall

- If you're going to play jazz in a reverberant space, you've got to adjust to that space
 - Compose/arrange for the space
 - Set up for the space
 - Play for the space
- Typical adjustments
 - Avoid fast tempos
 - Avoid big bass lines
 - Turn down the lows on bass amps
 - Minimize drums
 - Use “flowing” lines

What Makes a Room Good for Jazz?

- **Reverberation should be short**
- **No late echoes**
- **Not too big**
- **Lots of absorption**
- **Close in reflections for performers**
 - **Hard, low ceiling over stage and audience**
 - **Diffusion on side and rear walls of stage**
- **Absorption (curtains) behind drums!**
- **Hard surface behind piano**

What Makes a Good Sound System?

- **Carefully focuses sound on the audience while avoiding spill to walls, floors, and ceiling**
- **Natural sound, good dynamic range**
- **Uniform loudness and tonal balance everywhere in the audience**
- **Minimizes spill to the stage**

What Makes a Good Sound System?

- Carefully focuses sound on the audience while avoiding spill to walls, floors, and ceiling
- Natural sound, good dynamic range
- Uniform loudness and tonal balance everywhere in the audience
- Minimizes spill to the stage
- **So you should not hear much of yourself in a good system!**

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