

# 695 QUARTERLY

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**KENNETH TURAN, LOS ANGELES TIMES**

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# 695 QUARTERLY

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**Cover: *Les Misérables'* production sound mixer Simon Hayes and his formidable sound rig.**

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## From the Editors

As the calendar ticks over to a new year, we are filled with anticipation of brighter prospects and better times.

Hopefully, you have had some time to reflect with your family and friends and you are returning to a project or about to start one.

Competition is a factor both in the search for employment and on the job itself. Even though we are all working toward the same creative goal, it seems that departments are pitted against each other more and more, as if we were in a sporting event.



Imagine what the possibilities would be if in the first meeting with the director, his primary focus was on how best you can achieve a stellar soundtrack?

Well, that is exactly how it transpired on *Les Misérables* for production mixer Simon Hayes of Great Britain. This is an inspirational story of enormous cooperation amongst every department, with one goal in mind; to record all the live vocals perfectly.

This is an exacting business that requires great sacrifice. We wish you all a bountiful year, filled with endless cooperation from co-workers, friends and your treasured family.

Faternally yours,  
David Waelder, Eric Pierce and  
Richard Lightstone

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Foley Mixer: Frank Rinella



A FILM BY TIM BURTON  
**Disney**  
**FRANKENWEENIE**  
ADR Mixer: Doc Kane  
Re-recording Mixer: Michael Semanick, CAS  
Re-recording Mixer: Tom Johnson  
Re-recording Mixer: Chris Boyes  
Scoring Mixer: Dennis Sands, CAS  
Foley Mixer: Glen Gathard



**Disney**  
**WRECK-IT RALPH**  
ADR Mixer: Doc Kane  
Re-recording Mixer: David E. Fluhr, CAS  
Re-recording Mixer: Gary Rizzo, CAS  
Scoring Mixer: Alan Meyerson  
Foley Mixer: Frank Rinella



# From the President

## PISSED OFF...

There is a rampant elitism in the land. It is particularly virulent in our entertainment industry but it reaches across the culture and manifests itself as a methodical assault on the American Middle-Class' self-esteem. Labor is the enemy. The working man wants too much. Society can't afford to sustain the "Dream," while executives reap biggest-ever profits.



Our contribution to the process of creating entertainment is essential. No less than any collaborative endeavor, whether musicians in the orchestra or specialists in sports or the military. The process cannot continue without our participation. Yet, we have somehow devolved to a state of almost invisibility. This isn't good and it pisses me off.

Above-the-Line/Below-the-Line, Upstairs/Downstairs, Noblemen/Commoners, Brahman/Untouchables. A fair argument can be made that we have been willing participants in this precipitous decline.

True or not, we collectively must set goals and create strategies to reposition ourselves in the eyes of our industry. This must begin as a public relations/communications effort tied to the facts of our actual contribution.

It begins every day on the set. We, as individuals, are the best foundation for this new beginning. How we see ourselves and position our work relationships with our colleagues, employers and clients ultimately defines how we are to be treated by these constituencies as we engage in the process with them. In fact, if we take the opportunity to frame how we are defined, we start getting out in front of the direction this goes in.

A few principles I try to remember: What we do is essential to the process. If it weren't, we would not be invited to participate.

Just because the people we work with and for don't really know what we do, doesn't make them bad people. It's on us to communicate, in a clear, strong, non-adversarial or condescending way, our commitment to the project, the process and to excellence.

While focusing on our specialized tasks, we can demonstrate clear awareness and integration with the larger view/big picture. A band without a drummer has no beat, and a soloist who doesn't prepare, will lose his audience.

Do your homework.

We must embody the perception we want this business to have of us. It's the first step in resetting the position we have in the entertainment industry.

Fraternally,  
Mark Ulano  
President, IATSE Local 695

## 695 QUARTERLY

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# From the Business Representative



## In Perspective:

**Howard "Buddy" Alper**

Aug. 24, 1930 – Dec. 19, 2012

Soon after completing his service with the U.S. Army, young Buddy Alper found himself with a new career. It was 1955 and the entry-level job he landed was at that time called "Sound Production Cableman," placing him front and center in Hollywood's booming motion picture industry. Learning the ropes on countless soundstages and locations near and far, Buddy gradually worked his way up from Cableman to Microphone Boom Operator and eventually to Production Sound Mixer. His work gave him the opportunity to record sound on such memorable films as *Blade Runner*, the original *Rocky*, *Little Big Man*, *Breaking Away*, *Take the Money and Run* and many more, with numerous television credits, including such classics as *Dallas* and *Hawaii Five-O*.



**IATSE President Emeritus Thomas C. Short presents plaques for "50 Membership Years" to IATSE Local 695 retired members** From left: Gene Cantamessa (Y-1), Harold Landaker (Y-4), Short, Howard "Bud" Alper (Y-1), William Teague (Y-1).

Whatever the job, Buddy came to it with passion and a relentless commitment to top-notch production sound recording. His efforts were rewarded with multiple nominations for Academy Awards and BAFTA Awards.

Buddy understood the connection between the work he did and the union that represented him in the workplace, making his contribution to the IATSE with 52 years of active participation as a member of Local 695, including the years spent volunteering as an elected member of the Board of Directors. The day he received his 50-year IATSE Gold Membership Card from International President Thomas C. Short was indeed a proud one for both Buddy and for the members of Local 695.

With a larger-than-life presence that commanded respect wherever he traveled, Buddy Alper was a true champion of promoting the professional goals of recording audio in production, an inspiration to others and one of the most unforgettable persons to have promoted our 83-year history.

Buddy, rest with the angels, where I'm sure your presence will be noted. Thank you for our wonderful Local 695 relationship.

James A. Osburn, CAS  
Business Representative  
Executive Director

## NEWS & ANNOUNCEMENTS

### Pac-12 Network

Members of Local 695 and other IATSE locals turned out in large number to support the sports production crews as they successfully staged simultaneous job actions in Los Angeles, Phoenix, Eugene, Corvallis and Seattle against the Pac-12 Sports Network. The pickets were set up in response to the network hiring people for lesser wages and benefits than the established area standards.

The IATSE had shown flexibility with the network by granting contract waivers to accommodate budget restrictions on some product and has allowed student employment alongside professional technicians, but Pac-12 executives ignored all efforts of the IATSE to bring a more productive educational structure to the organization.

After this job action by production employees of the Pac-12 Network, including the refusal of IATSE professionals hired through signatory companies (Pettigrew, PCCC, BBP, and others) to cross picket lines, the network has agreed that a contract with the IA will be beneficial to their production needs. At the time of this writing, contract details are being finalized.

Local 695 has represented Sports Television Production Technicians for decades under contracts with broadcasters such as KTLA and FOX Sports, delivering programming for Major League Baseball, NBA, NHL, Major League Soccer, NCAA Sports, Boxing and much more.



Clockwise, from top: Picket line at UCLA; IATSE President Matthew D. Loeb (left) & Local 695 Business Rep James A. Osburn, CAS; picket line at USC.

### Membership Directory Offers New Features

The *Local 695 Membership Directory 2013* will be arriving in your mailbox in the next few weeks. New features include FCC LPAB call sign listings and the ability to put your **Skills** and **Areas of Skills** in the order you want them to be.



By default, the three membership directories (publicly accessible online searchable, members-only online searchable and the annual printed) will only list your name and classification, but you have the ability to add full contact information, skills and more! Simply log on to [www.695.com](http://www.695.com), find "Membership Directory" at the top of the page and click on "review/add/edit." Your directory page will appear and from there you can add information or make changes, and you can even customize the information in each of the three directories 24 hours a day, 365 days a year!

### Hurricane Sandy Relief Fund

Drawing from donations made by the IATSE and members of the IATSE, the Walsh/DiTolla/Spivak Foundation has so far provided assistance to 61 IATSE Brothers and Sisters and their families suffering financial hardship due to Hurricane Sandy. We thank those of you who stepped up to the plate and generously contributed. Unfortunately, the hardships continue and donations are still needed in order to continue providing this much-needed assistance.

If you can help, please make checks payable to the Walsh/DiTolla/Spivak Foundation and mail to the Foundation c/o IATSE, 1430 Broadway, 20th Floor, New York, NY 10018. Note on the check that it is a donation for "Hurricane Sandy Relief."

### In Memoriam

**BUD ALPER**  
Mixer

Aug. 24, 1930 – Dec. 19, 2012

**TIM MITCHELL DRURY**  
Boom Operator

Sept. 10, 1957 – Jan. 20, 2013



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It's awards season and we're proud that Local 695 is well represented in the sound categories. Here's a salute to all those nominated and their production sound teams!

The nominees were announced for the Cinema Audio Society's 49th annual awards. Ceremonies will be held February 16 at the Millennium Biltmore Hotel in Los Angeles, California.

## MOTION PICTURES LIVE ACTION



***The Hobbit: An Unexpected Journey***  
**Nominees:** Tony Johnson CAS, Christopher Boyes, Michael Hedges CAS, Michael Semanick CAS **Production Sound Team:** Corrin Ellingford, Chris Hiles, Sam Spicer



***Les Misérables***  
**Nominees:** Simon Hayes, Andy Nelson, Mark Paterson, Jonathan Allen, Robert Edwards **Production Sound Team:** Arthur Fenn, Robin Johnson, Paul Schwartz, James Gibb, Andrew Rowe, Duncan Craig



***Lincoln***  
**Nominees:** Ronald Judkins CAS, Andy Nelson, Gary Rydstrom CAS, **Shawn Murphy**, Bob Johanson, Frank Rinella **Production Sound Team:** Randall L. Johnson, Alex Names, Mark Agostino, Rachel Fleiss



***Skyfall***  
**Nominees:** Stuart Wilson AMPS, Scott Millan CAS, Greg P. Russell CAS, Simon Rhodes, Peter Gleaves, James Ashwill **Production Sound Team:** Orin Beaton, Lloyd Dudley, Thomas Fennell, Tim White, Hasan Sayin



***Zero Dark Thirty***  
**Nominees:** Ray Beckett CAS, Paul N.J. Ottosson, Brian Smith, John Sanacore **Production Sound Team:** Pete Murphy, Shaikh Firoz, Francisco Fernandez, Bruno Teves, Gary Dodkin

## MOTION PICTURES ANIMATED



***Brave***  
**Nominees:** Bob Johanson, Tom Johnson, Gary Rydstrom CAS, Andrew Dudman, Frank Rinella



***Frankenweenie***  
**Nominees:** Doc Kane, Michael Semanick CAS, Tom Johnson, Christopher Boyes, Dennis Sands CAS, Glen Gathard



***The Lorax***  
**Nominees:** Randy Thom CAS, Gary Rizzo CAS, **Shawn Murphy**, Frank Rinella



***Rise of the Guardians***  
**Nominees:** Tighe Sheldon, Andy Nelson, Jim Bolt, Peter Cobbin, Kyle Rochlin



***Wreck-It Ralph***  
**Nominees:** Doc Kane, David E. Fluhr CAS, Gary Rizzo CAS, Alan Meyerson, Frank Rinella

Names in bold are  
Local 695 members

## TELEVISION MOVIES OR MINI-SERIES



***American Horror Story: Asylum Part 1***  
**"Welcome to Briarcliff"**  
**Nominees:** Sean Rush, Joseph H. Earle Jr. CAS, Doug Andham CAS, James S. Levine, Judah Getz, Kyle Billingsley **Production Sound Team:** Dennis Fuller, Kriston Wilcox, John Bauman



***Game Change***  
**Nominees:** David R.B. Macmillan CAS, Gabriel J. Serrano, Leslie Shatz, Chris Fogel, Travis Mackay, Tor Kingdon **Production Sound Team:** Perry Dodgson, Lorenzo Milan



***Hatfields & McCoy: Part 1***  
**Nominees:** Dragos Stanomir, Christian Cooke, Brad Zoern, Jeff Vaughn, Eric Apps, Peter Persaud **Production Sound Team:** Marius Cosma, Gabriel Marin, Radu Nicolae, Dan Blanu



***Hemingway & Gellhorn***  
**Nominees:** Nelson Stoll CAS, Lora Hirschberg, Peter Horner, Douglas Murray, Marc Blanes Matas, Andy Greenberg, Don White **Production Sound Team:** Fred Runner, Lou Wiskes



***Sherlock: A Scandal in Belgravia***  
**Nominees:** John Mooney, Howard Bargroff **Production Sound Team:** Stuart McCutcheon, Abdulqader Amoud

## TELEVISION SERIES ONE HOUR



***Boardwalk Empire***  
**"The Milkmaid's Lot"**  
**Nominees:** Franklin D. Stettner CAS, Tom Fleischman, CAS **Production Sound Team:** Larry Provost, Sam Perry, Toussaint Kotright, Egor Panchenko, Tim Elder, Michelle Mader



***Breaking Bad***  
**"Dead Freight"**  
**Nominees:** Darryl L. Frank CAS, Jeff Perkins, Eric Justen, Eric Gotthelf, Stacey Michaels **Production Sound Team:** Jeff Perkins, Eric Justen



***Game of Thrones***  
**"Blackwater"**  
**Nominees:** Ronan Hill CAS, Onnalee Blank CAS, Mathew Waters, Brett Voss **Production Sound Team:** Simon Kerr, James Atkinson, Matteo De Pellegrini, Luke McGinley



***Homeland***  
**"Beirut Is Back"**  
**Nominees:** Larry Long, Nello Torri CAS, Alan M. Decker CAS, Paul Drenning, Shawn Kennelly **Production Sound Team:** Matt Fann, Jack Hill



***Mad Men***  
**"Commissions and Fees"**  
**Nominees:** Peter Bentley CAS, Ken Teaney CAS, Alec St. John CAS **Production Sound Team:** Christopher Sposa, Bud Raymond



## SALUTES THE 2012 CAS AWARDS NOMINEES

### TELEVISION SERIES HALF-HOUR



**30 Rock**  
"Mazel Tov, Dummies!"  
**Nominees:** Griffin Richardson CAS, Tony Pipitone **Production Sound Team:** Chris Fondulas, Bryant Musgrove, Larry Loewinger



**Californication**  
"Hell Ain't a Bad Place to Be"  
**Nominees:** Harrison "Duke" Marsh, Todd M. Grace CAS, Edward Charles Carr III CAS **Production Sound Team:** Abel Shiro, Kevin Patterson, Mike Mesirow



**Modern Family**  
"Disneyland"  
**Nominees:** Stephen A. Tibbo CAS, Dean Okrand, Brian R. Harman CAS **Production Sound Team:** Preston Conner, Dan Lipe, Srdjan "Serge" Popovic



**Nurse Jackie**  
"Handle Your Scandal"  
**Nominees:** Jan McLaughlin CAS, Peter Waggoner **Production Sound Team:** Brendan O'Brien, Michelle Mader



**The Office**  
"New Guys"  
**Nominees:** Ben Patrick, John W. Cook II CAS, Kenneth Kobett CAS **Production Sound Team:** Brian Wittle, Nicolas Carbone

### TELEVISION NON-FICTION, VARIETY OR MUSIC SERIES OR SPECIALS



**The 2012 Rock & Roll Hall of Fame Induction Ceremony**  
**Nominees:** Brian Riordan CAS, Jamie Ledner **Production Sound Team:** Richard Gizzi, Carl Glanville, Jason Gossman, John Harris, Skip Kent, Brian Kingman, Steve Lamphere, Bryan Leskowicz, Sean McClintock, Billy McKarge, Larry Reed, Joel Singer, Vinny Siniscal, Joel Tainio, Barry Warrick, Simon Welch



**Deadliest Catch**  
"I Don't Wanna Die"  
**Nominee:** Bob Bronow CAS



**Frozen Planet**  
"To the Ends of the Earth"  
**Nominees:** Archie Moore, Graham Wild



**Great Performances at the Met: Anna Bolena**  
**Nominees:** Ken Hahn CAS, Jay David Saks



**Sound Tracks: Music Without Borders**  
**Nominee:** Paul James Zahnley CAS **Production Sound Team:** Lupe Mejia, Chris McIntire, Andy Bowley, Jim Choi, Adriano Bravo

### BAFTA NOMINEES

The EE British Academy Film Awards nominations for "Best Sound" were announced January 9. The awards ceremony will be held February 10 in London, England.



**Django Unchained**  
**Nominees:** Mark Ulano CAS, Michael Minkler CAS, Tony Lamberti, Wylie Stateman **Production Sound Team:** Tom Hartig, Dirk Stout



**The Hobbit: An Unexpected Journey**  
**Nominees:** Tony Johnson CAS, Christopher Boyes, Michael Hedges CAS, Michael Semanick CAS, Brent Burge, Chris Ward **Production Sound Team:** Corrin Ellingford, Chris Hiles, Sam Spicer



**Les Misérables**  
**Nominees:** Simon Hayes, Andy Nelson, Mark Paterson, Jonathan Allen, Lee Walpole, John Warhurst **Production Sound Team:** Arthur Fenn, Robin Johnson, Paul Schwartz, James Gibb, Andrew Rowe, Duncan Craig



**Life of Pi**  
**Nominees:** Drew Kunin, Eugene Gearty, Philip Stockton, Ron Bartlett, D.M. Hemphill **Production Sound Team:** Mark Goodermote, "Malau" Kong Qiang, Shalini Agarwal, Francis Peloquin, Kathey Thibault, Ed Novick, Louis Piche, Evan Gilman



**Skyfall**  
**Nominees:** Stuart Wilson AMPS, Scott Millan CAS, Greg P. Russell CAS, Per Hallberg, Karen Baker Landers **Production Sound Team:** Orin Beaton, Lloyd Dudley, Thomas Fennell, Tim White, Hasan Sayin

### OSCAR NOMINEES

The Oscar nominees for "Best Sound Mixing" were announced January 10. The 85th Academy Awards ceremony will be held February 24 at the Dolby Theater in Hollywood, California.



**Argo**  
**Nominees:** Jose Antonio Garcia, Gregg Rudloff, John Reitz, **Production Sound Team:** David Alvarez, Eric Bautista, Greg Cosh, Jonathan Fuh, Edward Tise



**Les Misérables**  
**Nominees:** Simon Hayes, Mark Paterson, Andy Nelson **Production Sound Team:** Arthur Fenn, Robin Johnson, Paul Schwartz, James Gibb, Andrew Rowe, Duncan Craig



**Life of Pi**  
**Nominees:** Drew Kunin, D.M. Hemphill, Ron Bartlett **Production Sound Team:** Mark Goodermote, "Malau" Kong Qiang, Shalini Agarwal, Francis Peloquin, Kathey Thibault, Ed Novick, Louis Piche, Evan Gilman



**Lincoln**  
**Nominees:** Ronald Judkins CAS, Gary Rydstrom CAS, Andy Nelson **Production Sound Team:** Randall L. Johnson, Alex Names, Mark Agostino, Rachel Fleiss



**Skyfall**  
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# Recording *Les Misérables*

## Part 1: The Challenge

by Simon Hayes AMPS

“ The only way I feel  
we can make this movie  
is to record all of the  
singing live. ”

and mindsets. Of course, if a director feels he can find a better performance in ADR, it is a very useful tool, but it is such a shame when the cast and director think they have all really nailed a performance on the set, to re-record because of poor sound quality.

I had previously recorded musicals where small elements of live production sound were incorporated into the musical numbers. The last and best known of these was *Mamma Mia!*, starring Meryl Streep. Many musical numbers were lip-synced in the conventional fashion to a pre-recorded track prepared months earlier in a music studio. But there was a particular number that Meryl specifically asked to sing live. The action required her to climb a steep wall and she felt that the tracks prepared in the studio would not permit her to match her expressions with the action.

We kept a pre-recorded music and vocal track on standby but instead of playing the vocal and music out of a high-power amplified playback rig, we fitted her with an “earwig” and played her the music minus the vocal. This is a tiny, wireless, in-the-ear speaker that, once fitted, is difficult to see unless you are looking directly into the ear. Originally designed as hearing aids, they have been adopted by security professionals and other industries that require sending audio discreetly to personnel.

Tom Hooper, the director, dropped that bombshell on me in our very first meeting and those are the words that would intrude on every waking thought for the next 12 months.

I have always worked very hard to capture original performances and never rely on ADR; I believe that performances captured on a movie set are rarely bettered in the isolation of a vocal booth, without the presence of other cast members, and months after the movie has wrapped. By then, the actors may be shooting another movie and be immersed in completely different characters, accents



Russell Crowe and Hugh Jackman, can you see their microphones?  
(Photo: Laurie Sparham/Universal Studios)



The production sound crew of *Les Misérables*, from left: Simon Hayes, Production Sound Mixer; Paul Schwartz, Sound and Music Maintenance; Arthur Fenn, Key 1st Assistant Sound; James Gibb, 2nd Assistant Sound; Robin Johnson, 1st Assistant Sound. Missing from photo: Andrew Rowe, Sound and Music Assistant; Duncan Craig, Sound Trainee.





Lectrosonics SMV, DPA 4071 lavalier microphones with DPA 'concealer' mounts and costume fabric swatches to assist disguising the microphones.



A disguised DPA microphone

The recording we made on *Mamma Mia!* was successful. This experience gave me confidence that, although risky in comparison to going the pre-recorded playback route, recording live singing on set is achievable. It gives a vocal performance that more closely matches the on-screen visual performance.

So, in that first meeting when Tom asked me if I thought it was possible to shoot the whole of *Les Misérables* live, without hesitation I answered, "Yes." As Tom and I spoke, he told me of earlier experiences in his career that had resulted in him gaining a respect for production sound and a dislike of committing performances to ADR.

We began to formulate a plan to serve as a rudimentary workflow for the film. He said to me that he knew there had been major technical advances in recent years, not just in the equipment we use to capture sound in films, but in every sector of the movie industry and within the wider electronics industry. His next comment really shaped my own opinion and confidence in how seriously he was committed to recording the film live when he said, "I want you to use every single piece of modern technology available to us to record the performances on the set live with high-enough quality that will ensure we won't need to return to an ADR studio to re-record performances because of poor sound quality." This was the backing I needed to realize his vision and take on a unique project that had never been attempted before.

Let me take a moment to qualify that last comment: In the early '30s before modern production and post-production techniques, singing was recorded live on movie sets. This was before the idea to pre-record vocals and lip sync to playback had been conceived, and before the ability to ADR performances in post-production existed. These very issues become the subject of the famous movie, *Singin' in the Rain*.

However, to my knowledge, none of those movies had attempted a workflow that allowed the actors to set the tempo, with the timing of their acting taking precedence over the musical orchestrations. This was Tom's revolutionary idea. Having agreed with him that it was

possible to record vocals with high-enough quality on the set to use in the finished film, he then began to explain to me the next piece of his unique plan.

He asked me about other live recordings I had done using a pre-recorded track for the talent to sing to. "What would have to happen if an actor wanted to take a moment to reflect on something within their vocal performance?" My reply was that it was possible to take tiny moments but only within the strict confines of the pre-recorded music track being played to them in their earwigs. Tom went on to ask, "What if they want to take a longer break, a larger pause?" I replied it would be impossible because the vocal would become out of sync with the music. Tom said to me that was exactly what he wanted to avoid. It was his vision that actors would be able to reflect on emotive moments or take time to complete actions without being worried about falling behind the music. They would set the tempo and the orchestration would happen in post-production. The orchestra would play to the actors' performance and the acting would drive the music, not the other way round.

At this point, I knew he was asking me to take part in a venture with huge risk, something that had never, to my knowledge, been attempted before. As Tom waited for my reaction, I thought carefully. He asked me if I was prepared to try this and I asked if there would be any pre-recorded music at all. He said no. He wanted the actors to be followed by an electric keyboard played on-set, with the pianist reacting to the actors' performance rather than setting tempo in the customary fashion.

I responded that I had the technology that would allow the actors to hear the piano in a hidden earwig so that microphones could pick up a clean vocal recording. If the music department and picture editor could support Tom's vision to orchestrate afterward, I certainly had the ability to successfully bring this methodology to the movie set.

Tom then told me about his collaboration with Gerard McCann, his supervising music editor. Gerard had also worked with him on *The King's Speech* and shared his conviction that allowing the acting



to set the tempo of the music was a valid approach. He asked me to meet with Gerard as soon as possible so we might immediately begin collaborating on developing a methodology to achieve these ends. We had now been talking about two hours continuously and this was our initial meeting!

Discussing the technical challenges of recording the singing live, Tom told me he would need to cover the action with multiple cameras. If the cast made a perfect take, he would want to have it well covered with wides, mids and tights all at the same time. Being able to preserve a "perfect" take was only part of his vision for the film; he also wanted to allow his actors to freely overlap their lines. That technique can greatly enhance performance authenticity and vibrancy but it presents difficulties for the editor who must find a place to make cuts. It also necessitates that all speaking and singing roles must be recorded on-mike at all times, whether on-camera or not. If the sound mixer has both actors (on screen and off screen) covered, it is possible with a skilled picture editor and dialog editor, to preserve the on-set performances by carefully weaving in and out of the speeches, cutting on syllables and tiny pauses. Utilizing both multiple microphones and multiple cameras, it is possible to exercise control over the material. Adding to the complexity, Tom intended to extend this flexibility to interactions between the principals and the chorus. He and his DP, Danny Cohen, planned to use as many cameras as needed to ensure that every good performance would be captured sufficiently so that re-takes for coverage would not always be needed. This was his plan for filming *Les Misérables*.

I agreed wholeheartedly that this was the best way to bring the immediacy of a continuous theatrical performance to the film audience as I began to formulate the plan of how I might accomplish the task.



Left and above: Hugh Jackman with his microphone visible and a close-up. Later painted out via CGI. (Photo: Laurie Sparham/Universal Studios)

We discussed why boom mikes are traditionally the preferred method for capturing movie dialog and why radio mikes are generally treated as a secondary method. I explained to Tom that Production Sound Mixers usually favored boom mikes because radio mikes historically had three huge issues compromising their reliability. The first was range. It is only in recent years that radio mikes presented enough range to be able to be used on movies without indiscriminate splots, pops and hiss. The development of the Lectrosonics digital hybrid system has been a great step forward, yielding not only far greater range but also a significant improvement in sound quality generally. Results are practically indistinguishable from a cabled system. So, issue number one was covered and range was no longer a problem.

The second issue was that lavalier microphones have always been compromised by their tiny size. Their sound quality has always been a long way behind what was considered "studio quality" in the music industry. Performance on a set has been inferior to what can be accomplished with a well-placed boom microphone.

Calling again on my experiences on *Mamma Mia!*, I knew that there was now a better answer. I tested many mikes for that film and found that the difference between the various lavs on the market was just a matter of audio taste. There wasn't one product that could really be called "better," just many products each with their own audio voice. Some on my crew would prefer one and some another. During discussions about the small live element limitations of lavaliers, I met with Benny Andersson from pop group Abba and his longtime engineer, Bernard Lohr. They told me that when they first took *Mamma Mia!* onto the stage, they were presented with lavaliers for the first time, and coming from a music industry background, had no experience with them. They also tested products from many different companies and were consistently disappointed. Then they asked DPA (a Danish company whose studio products had already impressed them) if they could test the company's range of lavaliers. Benny and Bernard both told me that DPA lavaliers were the closest tonal match to the mikes they used in the music recording studio and that the *Mamma Mia!* stage musical had benefited greatly from their sound quality.



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To confirm the wisdom of this choice for the vocals in *Les Misérables*, I set up a test with the DPA 4071 against the three strongest alternate candidates and invited my crew to participate. This time, everyone was in immediate agreement that the DPA 4071 was the winner. It seemed to sound less closed, chesty and constricted than the other lavs and exhibited an openness previously heard only on good-quality condenser mikes used on a boom. It was a really transparent mike that, unlike the others, didn't add its own "voice" to the recordings.

The other problem I had experienced with lavs was their inability to cope with high SPLs. When you most needed them on scenes that were challenging to boom, like fight sequences or exterior action sequences where the talent was likely to be shouting or screaming, they would often distort due to their capsule being tiny and 'hitting its end stop.'

I was impressed that the DPA could handle amazingly high SPLs. Toward the end of the test, members of my crew were screaming into it while it was rigged on the chest, trying to get it to crack off and distort but it remained smooth. Yet when the vocal was brought down to the quietest whisper, an almost 'breathed' dialog, it was sensitive enough to capture the change in level instantly and without coloration.

Upon research I found out that DPA had designed the lavs not just with vocals in mind, but that they had created a tiny mike that could be used in music recordings when an instrument needed to be closely yet discreetly mic'd. This gave me enormous confidence in my decision to use them for live singing on *Les Misérables*.

So I knew that I had a good microphone candidate to address the issue of recording the singing with clarity and accuracy.

The third issue with radio mikes did not have such an easy answer. It is the primary reason that, even with huge advances in radio and microphone technology, most Production Sound Mixers still prefer to capture dialog with boom mikes and rely upon radios only when a boom cannot be effectively deployed. Lavaliers must be hidden underneath costumes. Whether the clothing will "sound good" or cause rustle over the dialog is often a gamble because the visual choice of costume generally takes priority over radio mike placement. If an actor is wearing a nice cotton T-shirt, it is possible to get really great sound quality but, if the costume designer needs to have the actor in a silk shirt, the dialog may be unusable. The "plug-ins" now available to dialog editors and re-recording mixers have become amazingly advanced and many background noises can now be effectively cleaned up but severe clothing rustle remains notoriously difficult and removal efforts will often remove some frequencies of the voice as well. On normal dialog a small amount of cleaning up of the voice may be acceptable but the artifacts of a 'cleanup' are much more noticeable with singing.

I decided to take up Tom on his challenge to use every advance in modern technology to enable us to record the best quality vocals possible.

I explained to him that the booms would have to be a secondary way of capturing the vocals due to the multi-camera cinematography.

Sure, the booms would work fantastically on some shots but we could not completely rely on them. For radio mikes and lavaliers to be our primary method of recording voices, we needed a plan to effectively eliminate clothing rustle. My proposal to Tom was that we place the mikes on the outside! To his credit, he continued to listen to me although my suggestion completely broke with film industry tradition.

I intended to take advantage of advances in CGI to allow greater freedom in microphone placement. I proposed working closely with the costume department and obtaining swatches of matching fabric that might be used to cover the microphone mount. A small cut in the exterior of the costume would permit mounting the mike on the outside and a camouflaging piece of matching fabric would make it inconspicuous. Since the mikes would be attached using DPA's recommended mount, and since no fabric would touch the grill, the application should be noise-free. Although the mike would be clearly visible to the human eye, on a wide shot and on a moving costume, it would be very difficult to see, and on a tight shot it would actually be beneath the bottom of the camera's frame line. For the medium shots we would rely upon advances in VFX technology to paint out the mikes. Tom was immediately 100% receptive to this idea, commenting that the VFX department could spot the mikes that needed removal once picture editing was complete. At that moment I knew that not only had we formulated a unique plan, eschewing many age-old film industry traditions, but also that the plan placed an importance on production sound that I had previously only dreamed of.

At this point, Tom and I had been talking for three hours and he told me he had another appointment. I expected the meeting to end when he told me that Hugh Jackman was rehearsing with the Music Director, Stephen Brooker, Cameron MacIntosh's longtime collaborator, and I was honored when he asked me to come and meet them both.

As I walked into the studio, Hugh was in mid-song and I was struck with the huge dynamic range of his voice and what an accomplished singer he was. At the end of the song, Tom introduced me to both Hugh and Stephen and explained I was the sound mixer who was going to record the musical live. Hugh looked at me warmly and told me how impressed he was that I had taken the challenge. I couldn't have met two more welcoming individuals who would turn into friends and collaborators in the coming months.

Over the next few days, I began the task of technically planning what I would need to facilitate Tom's vision.

I began to think deeply about the project and my previous experiences working on musicals. Since the singing was pre-recorded and the singing was generally lip-synced, the tempo had been set months in advance of the actors coming on set. Tom had explained to me that he felt live singing held an energy and truth that miming could never fully replace and he believed he could detect a falseness that disconnected the audience from the performance.

I considered this. His thinking about mimed singing closely paralleled my thinking about ADR in general. A few lines in an action scene might pass unnoticed but longer passages can be ruined by the need for dialog replacement. I began to think about normal musicals where a singing number might run for three minutes followed by

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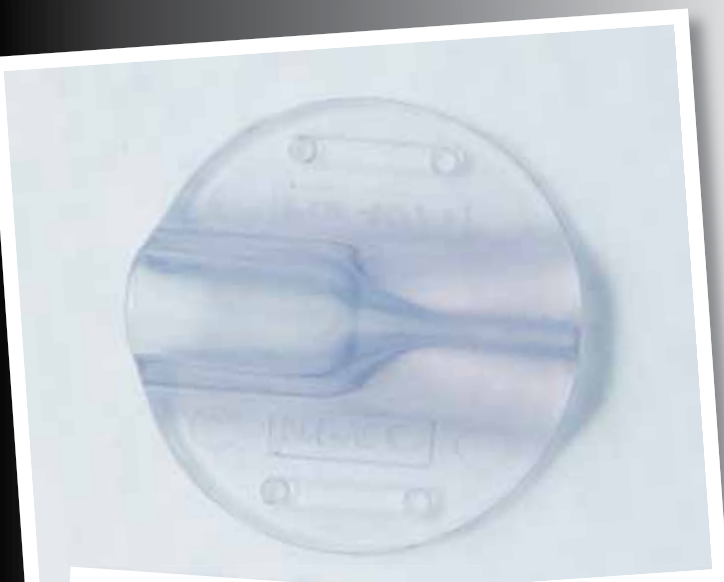
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Top: DPA 'concealer' microphone mount.  
Center: Close-up of a DPA 4071 microphone.  
Above: A disguised DPA microphone.

dialog scenes and then by another musical number. The singing would be mimed to playback and the conjoining dialog scenes recorded live in the usual manner. I believe that the audience senses miming immediately but they are conditioned to accept it by other musicals and by MTV experiences. They can subconsciously accept the theatricality for a short while as part of the willing suspension of disbelief. Just as the acceptance is becoming ragged, the musical number ends and the audience again experiences live recording and forgets the distrust building during the mimed number and the cycle starts again. We accept this pattern of connect and disconnect because recording live singing is so difficult and time-consuming. To ask an audience to connect with a lip-synced mimed performance for more than 2½ hours would, I think, run counter to their instincts.

This led me to another subject I considered while planning *Les Misérables*: why do audiences not connect with ADR and miming?

In my opinion, we, as human beings, have incredibly sensitive instincts that stem from our beginnings and are deeply rooted in our genetics. When connecting with other human beings, we are predisposed to process and evaluate the subtlest facial expressions, changes in voice, mannerisms and body language. Why do we do this? To try and work out whether the person we are talking to is honest, whether he is worthy of our trust. This is an instinctive part of survival and taps into our most basic reactive quality: fight-or-flight. We do this subconsciously most of the time, only noticing a problem in our conscious mind if our subconscious has flagged an alarm from our continuous evaluation.

The more I thought about this, the more obvious it was that the cinema performances that engage us are the ones that our subconscious accepts as true. A truly great performance is one that keeps the audience in the moment and doesn't allow any subconscious alarm bells to ring, bringing us back to reality and creating distrust in the performance.

Tom Hooper's vision of a completely sung through *Les Misérables* would not, in my opinion, have kept an audience captivated for long if it been lip-synced from start to finish; there would have been an eventual disconnect for even the most ardent of fans. After all, who would go to see a stage play that was mimed?

Before commencing technical preparations, I met with the producers to explain my plans. I am fortunate to have an excellent working relationship with Working Title Films, having recorded several films for the company, and I've worked with producers Eric Fellner, Tim Bevan, Debra Haywood and production executive Sarah Jane Wright many times. I explained that to make the project possible I would need a much larger crew than usual. I always use two boom operators on my projects so I may record off-camera lines, giving the editors more options and reducing the need for ADR. So they were familiar with my preference for a larger crew but this project had even larger needs than usual. I intended to use two boom operators with mono booms to capture the individual singing lines and also a 3rd boom fitted with an MS stereo mike for the chorus and group ensembles. Members of the chorus would be individually radio mic'd but this track would add width and texture to the recording. I had also worked out that on most days we would be



Assortment of costume "offcuts" for disguising the microphones and a fabric swatch used to disguise the DPA microphone.



running as many as 20 radio mikes and 75 ear pieces so I would need two sound assistants just dedicated to rigging radio mikes and wrangling earwigs—a huge task in itself. To really be able to guarantee sufficiently quiet backgrounds for Tom to use the live on-set vocals, we needed a member of the sound team whose sole responsibility would be generally spotting background noise issues as they arose and dealing with them professionally and swiftly.

The need to have all the participants mic'd-up for rehearsals was a further complication. In a normal shoot, the cast can sometimes do early 'block through' rehearsals without being mic'd to save time and then be rigged just before final rehearsals. Our plan for *Les Misérables* called for the lead singers to take their own pace and a piano accompanist would follow them and provide a tempo for the chorus and other singers. Since the pianist was to be off-set to keep the piano clear of the recording, it was essential that he hear the performers through their mikes and that his piano track be fed to earwigs worn by all the actors. This meant it was imperative all the actors were fully rigged before the first rehearsal. This was nothing new to me and my team having just finished Ridley Scott's *Prometheus*, where all the actors had to be mic'd inside their space helmets and fitted with earwigs so they could communicate with each other inside the soundproofed glass helmets. Of course, it took a while for the rest of the crew to realize it wasn't possible to call a rehearsal unless the sound team had completed rigging the actors.

Debra and Sarah-Jane agreed that if Tom wanted to shoot the musical live, the sound team had to be employed in larger numbers than a regular movie. They understood that usual crewing levels in the sound department could cause schedule issues while shooting due to the far greater workload.

At this point, I could put together my dream team: a seven-man sound crew.

Arthur Turner and Robin Johnson, my boom operators, have been working with me since 1997. We've done more than 40 movies

together and work as a tight team. We each know our roles and can work out complex issues quickly and efficiently with minimal discussion. For this project, Arthur and Robin held the titles of Key 1st Assistant Sound and 1st Assistant Sound, respectively. Since the project was unique, and their roles and responsibilities were so much more than pure boom operating, we thought it right to use titles more in-line with our colleagues in the camera department.

Joining Arthur and Robin would be Paul Schwartz, who has often worked with us as a 2nd Unit Boom Operator. He would be operating boom number three, the stereo boom and also help coordinate the production sound equipment and interface with the music department's Pro Tools rig. His title was Sound and Music Maintenance.

James Gibb would be our 2nd Assistant Sound and would serve as chief radio mike and earpiece technician. He has worked with us on about 12 movies and is very capable. We brought in Andrew Rowe, another collaborator from 2nd unit work on other pictures, to assist James with radio mikes and earpieces. He would also be responsible for talkback systems and monitoring.

Duncan Craig was brought aboard as Sound Trainee. He has worked three films with us so we were privileged to have someone so experienced in that role. His responsibilities were carpeting the actors' feet, soundproofing anything noisy and generally helping with anything sound-related.

So, we had a seven-man sound team in place—a bigger main unit crew than I had ever worked with before. They were all hand-picked from the best technicians I know and all excellent choices not just for their individual skills but also for their experience working together as a team. As events would prove, this large crew was absolutely necessary for the job required.

*Editor's note: In Part 2, Simon Hayes will tell us about the implementation of these plans.*



# Archiving on Flash Media

*by David Waelder*

**After 150 years, the negatives that Timothy O’Sullivan exposed for Mathew Brady at Gettysburg still yield prints. Many of the glass plates were recklessly discarded after the war, but those that survived still hold images and the pictures have become part of our cultural legacy.**

There is no format for digital storage that can match that performance, no gold standard for archiving audio information. Reel-to-reel magnetic tape is generally considered fairly stable but it is vulnerable to emulsion shedding and delaminating after only 10 years. With careful storage, tape will usually have a life expectancy of at least 30 years and is often playable after more than 50 years.

Experience with digital files on magnetic or flash media is still so brief that any advice must be flagged with an asterisk. Hard drives all fail eventually but a RAID storage on multiple drives seems to be reasonably dependable. Flash media is very promising as there are no moving parts, no spinning disc and floating head that might collide, no lubricant to dry out and no layers that might lead to the delamination that is a vulnerability of optical discs.

Until someone devises a universally accepted archival format, we will have to be satisfied with pretty good performance. And, by any reasonable standard, long-term storage is the responsibility of the producer, not technicians who may be hired on a day-playing basis. Still, when turning in the day’s work, one wants to be sure that its important content will be more permanent than a drawing on an Etch A Sketch.



Gen. Winfield S. Hancock with other generals, Francis Barlow, David Birney and John Gibbon, 1863. (Photo: Mathew Brady, National Archives)



SanDisk first developed the Compact Flash (CF) in 1994. It originally used the Intel NOR flash memory design but later changed over to Toshiba's NAND memory management protocol. The Toshiba protocol incorporates a "memory leveling" operation to evenly distribute writing among the sectors for even wear.

Flash memory is comprised of two elements: the matrix of memory cells and a separate controller circuit that manages the flow of data. Manufacturing irregularities may produce bad sectors in the memory cells but the controller circuit is programmed to identify and map those sectors and remove them from active use. This provision to permit some compromised cells makes it possible to economically manufacture a reliable product. Since manufacturers are all getting their memory wafers from the same few sources, the design and construction of the controller circuits is the primary distinction between a cheapo and a premium memory card.

In practice, the CF cards have proven to be remarkably resilient, surviving accidental trips through the washing machine, exposure to magnetic fields and extreme environmental conditions. Even the standard cards operate in temperatures ranging from freezing to more than 120°F and the range for safe storage is even wider.

There are some known issues that can cause memory loss. Most of these are related to errors in writing protocol, like removing the device before properly closing down. Flash memory can also be damaged by static discharge and by writing with a failing power source such as a discharged battery. Although they seem to shrug off airport X-ray machines, the cards are vulnerable to the more powerful scanners used by the post office and should not be mailed unless contained in a shielded pouch.



The interior circuits of a CF card. The controller is on the left and the memory chip on the right.



Recommended flash card brands

When a memory card loses data without any identifiable cause, like a static discharge, it is almost always a failure in the controller circuit rather than a failure in the memory cells themselves. This is an important distinction as it means that the data is really still on the card and available for recovery. Sometimes recovery can be accomplished with software programs but, with a cataclysmic controller failure, it may be necessary to send the card to a specialty company that has the equipment to bypass the bad controller and access the data matrix directly. This may not be cheap or convenient but it's an argument in favor of flash memory storage that it is almost always possible to restore the original files.

Estimates of archival storage capabilities run the gamut from cards that lost data almost immediately to cards that have been stable for many years. General consensus is that cards that accept formatting without incident are likely to be reliable for many years. The market is infested with counterfeit cards and this may explain some of the premature failures. For use as an archival master, it is especially important that cards be purchased from a reliable source. Location Sound, Trew Audio and The Audio Department all take pains to get their flash media from reliable suppliers. Favored brands are Delkin Devices, Transcend and SanDisk.

Nikon and Canon continue to use Compact Flash as the primary storage medium in their high-end cameras and Leica uses it in their new medium format camera. This is significant because photography has been one of the primary applications for Compact Flash; continued use in professional and semi-pro equipment assures that the format will be viable for the foreseeable future.

For very long-term storage, magnetic media in RAID arrays with regular data transfers is preferred to any flash media. SanDisk does offer a Memory Vault they claim to be suitable for storage "up to a century" but the product is too recent to have any track record and, in any event, is not configured for direct connection to recorders. For very long-term storage, users will have to encode their data onto wet-plate collodion emulsions on glass.

# CF Cards As Masters

by Thomas Brandau

While I'd like to thank Scott Smith, CAS for starting the conversation about digital asset management, I'd like to revisit that oft-heard saying that "In Hollywood we don't plan, we just do it, then spend whatever time necessary to fix the problem, then declare ourselves expert at something else."

Recently, the post supervisor on a network series came down to the set with a list of WAV files to ask if we could get him copies from three episodes ago. They were handed in and went through the dailies process so, if they had been missing on the day, we would have heard about it long before. No reason was given for the request, but I have to assume "something happened to them." They were either on my 788T or on the other unit's record machine. No problem really, we just needed to know who shot these files and on what day of the episode. Of course, the timecard question came front and center, that being: when was I to look for these files, at wrap or lunch? And, of course, there was the problem.

In another situation, a feature film this time, the picture had been locked and, as sound editorial was conforming the sound, several days' work had gone missing from the drives. Again, picture editorial had received the files, dailies discs had been struck and distributed, but at the last stage, now a problem. It's simply amazing how quickly and how hot it got. "Where are your backups, how did this happen?" etc. The incident went up the chain to studio management in a day.

In this case it turns out that the DIT guy had the whole show on his drives and, as he hadn't worked since the shoot, he hadn't formatted and erased the sound or picture files. They were recovered and it only remains to troubleshoot how and at what point these files disappeared from both a primary and backup drive.

Lesson learned: Compact Flash (CF) cards are relatively cheap. In the old days, we'd turn in four or so 1/4-inch master tapes each workday, easily \$300 a week. Why are we reformatting this media? The current workflow is for sound to give the Compact Flash cards to the DIT guy or gal (or to whoever is downloading the picture files) to be included with the picture files on the same shuttle drive going to post. The original files remain on those CF cards and on the internal drive on my record machine.

Again, why would you erase the "master cards"? With good file management, sound will fill four or five 16GB CF cards every week. Or two 32GB cards, assuming you fill those cards and make daily files for editorial to track.

Personally, I like 16GB cards. If one is lost or destroyed, there's less on it, and then there's the time required to format and load 32GB cards. You can argue however that 32GB cards are a bit more cost-effective and you'd be right.

Which brings us to the subject of the speed and quality of the media itself. Of course, you want the best quality and a reliable product, goes without saying, but it's also true that a machine running all eight tracks will only need 133X or 166X cards. This comes directly from Sound Devices. Poly WAV files are just not that large or complicated to require faster write speeds. With every reformat you are asking the card to overwrite the data. I know of no one taking the time to lo-level format, so when you "erase" the card you are simply telling the directory to overwrite the sectors. This is where the digital errors come in to play.

There is so much talk about digital permanence that I contacted some manufacturers directly. It's interesting that the story is the same wherever you go. Flash and SSD memory "wafers," as they are called, are pretty much like LCD screens: identical, all coming from the same factory. It's the build and the video amplifiers that make the difference between television brands and the same is true with memory.

The controller on the card or drive determines accuracy and permanence. SanDisk and Delkin make their own controllers, and Transcend, Kingston and others out-source theirs. Also, there are "industrial" and "consumer" controllers. A German company, Hyperstone, makes bulletproof industrial controllers for single-layer Compact Flash cards. These are used in all the mil spec and medical applications where failure or loss of data is not an option. Single layer, write once, cards are about \$300 for 16GB. We are all using MLC, multi-layer media, but that doesn't mean we can't treat our cards like SLC media.

So, I'm arguing for good-quality cards, written once and held as a master library, for what, \$150 a week at retail?

It's also astounding to me that what is essentially the camera negative, as a common QuickTime file, is being copied drive to drive without any real thought of longevity and security. With a 7200rpm G Drive, it's not if, but when that media will fail. And just think of the rental Avid workstations or the DIT guy with your camera "negative" and sound masters in his garage after the shoot.

A subject for another day, but how can the studios and producers allow this?

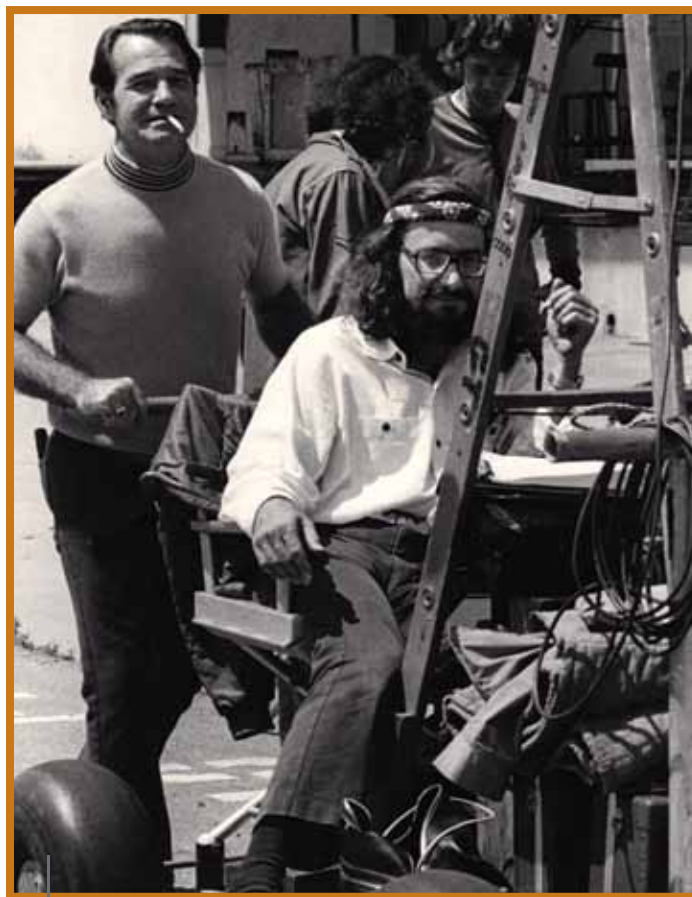


by Jim Tanenbaum, CAS

# The Cable Connection Part 4

## CHECKING YOUR RECORDING CHANNEL FOR CROSSTALK PROBLEMS

When you have finished configuring your sound cart, begin checking for problems. You will have to repeat the tests several times, monitoring from your recorder, backup recorder (if used), and mix panel. When you have finished with this first round of testing, check all your sends: Comtek, feed to video assist, etc., for crosstalk in them.



In the bad old days (1972), radio links were not reliable. Two non-diversity VHF receivers are on top of the ladder, and my boom op, Jim Heinlen, has to push me around on a western dolly during the shot to stay within range.

You will need a battery-operated tone generator, with 100 Hz, 1 KHz, and 10 KHz sine wave frequencies, both mike and line-level outputs, and adapter cables to allow you to connect to whatever type of audio input connectors (XLR, TA, etc.) your equipment uses. “Dummy” loads to terminate open cables or inputs are also helpful in tracking down the more refractory cases, but you may not need them. I made male and female XLR connectors with metal-film resistors (low internal noise) soldered between Pins 2 and 3: dynamic mike = 150  $\Omega$ , condenser mike = 2 K $\Omega$  in series with a 100 mfd NP tantalum capacitor, line = 600  $\Omega$ , and hi-Z = 20 K $\Omega$ . All the shells are connected to Pin 1.

Without getting too deeply into electronic theory, *capacitive crosstalk* is characterized by an increased proportion of higher frequencies—it sounds tinny, like a really old-fashioned telephone. This type of crosstalk increases as the distance between the two wires decreases. Furthermore, it requires only a source voltage, not current (e.g., the headphone feed in a duplex cable when the boom op’s phones are not plugged in). The type of insulating material separating the two wires doesn’t make too much of a difference.

*Inductive crosstalk* is the inverse of capacitive in that low frequencies couple more easily than high ones, but here the surrounding material makes a difference: ferrous material couples a magnetic field much more effectively than air for low frequencies. However, you will not encounter this situation often because there is seldom any iron or steel involved. Inductive crosstalk requires current to be flowing in the source circuit, so in the example above, if the crosstalk increases when the boom op’s phones are plugged in, you now have a contribution from inductive coupling. (Or not—the current drawn by the headphones will increase the IR drop, so there will be less voltage to capacitively couple.) In addition to an increased level, you may notice a greater proportion of lower mid-range frequencies.

(Or not—it depends on how tightly the two wires are twisted, and how evenly.)

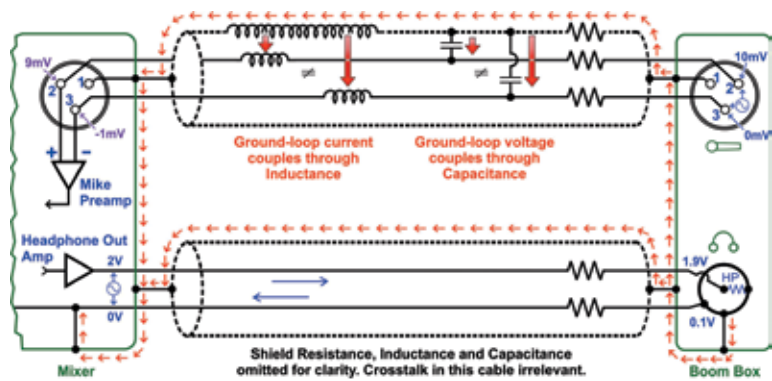
**Follow the procedure below to check your gear for crosstalk or interference pickup:**

1. To begin, be sure all equipment is switched off.
2. Disconnect all cables from the mixer’s channel inputs. Turn on the mixer and push all the faders to full open. Turn the headphone volume all the way down, in case there is a routing problem and the full-level tone goes directly to them. Plug your headsets into the mixer’s jack and slowly turn the volume all the way up. You should not hear anything except a faint hiss. Turn down the volume (to avoid any transient pops) and switch on all the other cart-mounted equipment, one unit at a time. Raise the headset volume to listen as each new unit is powered up. If the hiss or any other sound is noticeably louder, investigate the reason.
3. Make sure the headphone volume is down. Set the tone generator to 1 KHz at mike level, and plug it in to the mixer’s Channel 1. Adjust the channel fader and trimmer to give a 0 dB (full scale) reading on the mixer’s meter. Solo all the other channels and listen for crosstalk, turning the headphone volume up to listen and then down again for each channel. You will hear a certain amount of crosstalk, perhaps -55 dB to -70 dB down. It should be the same on all the other channels, or slightly louder on the adjacent Channel 2. Repeat this procedure with the generator set to 10 KHz. The crosstalk level may be somewhat higher. Then repeat with the generator at 100 Hz. The crosstalk should be noticeably lower. Now move the tone generator to Channel 2. Listen for crosstalk on all the other channels. Continue to move the tone generator through all the remaining channels. Finally, pull all the faders down and listen for any tone bleed-through. This sequence of tests establishes the baseline crosstalk level for all the following tests.
4. Repeat these mixer crosstalk tests with line-level inputs. Be sure to use the separate line input connectors if provided, instead of simply padding down the mike inputs. You may notice slightly more crosstalk because of the increased voltage entering the mixer’s internal wiring, especially the faders-closed test. This is normal, if the increase is not excessive.
5. NOTE: The above tests are extra-sensitive because the inputs are open-circuited. When a mike or other device is connected, the residual noise floor will be lower. You could check this by connecting the appropriate dummy load, but at this stage it is probably not necessary.
6. Connect the radio mike receiver outputs to the mixer inputs. As a general practice, use the receiver’s line-level outputs and the mixer’s line inputs. Depending on the type of radio mikes you have, they may produce more hiss or other noises when the transmitters are off. Turn on the transmitters (without a mike plugged in) to ensure that all the receivers mute/squelch properly. After you have checked for noise in every receiver, move the transmitters around your cart to see if their RF gets in anywhere. When finished with this test, switch off all the transmitters and disconnect the receivers.
7. Make sure your mixer is connected to the recorder in whatever arrangement you use (e.g., mix to Ch 1, ISOs to Ch 2, Ch 3, Ch

## K-Tek Klassic Pole







Ground-loop current flow and induced crosstalk in a duplex boom cable

4...). Turn the recorder’s headphone volume all the way down, then move your headphones to the recorder. Use the mixer to send a 0 dB tone to the recorder’s Channel 1, and then listen to all the other recorder channels for crosstalk. Turn the headphone volume up slowly each time. Next, connect the tone generator to the mixer input that will send a tone to the recorder’s Channel 2 and listen for crosstalk on the other recorder channels. Finally, check all the other recorder channels in the same manner.

8. If you use a backup recorder, perform the same tests on it.
9. Check all the external feeds, starting with the Comtek (or whatever wireless monitors you use). Use closed-cup headphones to reduce bleed-in of outside sounds. Be sure the Comtek receiver’s volume control is all the way off. Start with all the faders down on the mixer. IMPORTANT: You will need to calibrate the Comtek receiver’s output level to match the mixer’s. Temporarily reduce the tone generator’s output to -30 dB, and open the corresponding channel fader to give -30 dB on the meter. Slowly raise the mixer’s headphone volume to maximum, raising or lowering the tone generator’s output level to give you a comfortable SPL (Sound Pressure Level) in the headphones when the volume is full up. Now alternate plugging in your phones from the mixer to the Comtek receiver, adjusting the receiver’s volume control until the tone levels match. At this point, the control should be near maximum. If you can’t get the tone as loud with the control all the way up, you will have to make a mental note of how much lower it sounds, and judge the test results accordingly. If you reach the same loudness with the control well below maximum, especially if it is below the point where it is usually set, there may be a problem with the level of the signal going in to the Comtek transmitter—check it. It is also possible that the sensitivity and/or impedance of your headphone is markedly different from the lightweight phones you use with the Comtek—compare them.
10. If you have found no crosstalk or interference problems, give thanks to Murphy and take a break. But if you do have trouble, keep your headphones on and check the following:
11. Is the trouble in only one device? (e.g., in the recorder’s headphone monitor but not the mixer’s?) Unplug the audio, video, and timecode cables from it one at a time. If the problem persists, power it from another source. (e.g., if you have a common 12-volt supply on your cart, unplug the equipment and run it from a separate battery.)
12. Can you tell from the sound what kind of crosstalk or interference you have? (e.g., if the problem is TC bleed from recording

TC on one audio channel of the recorder, have you used an external pad to drop it 20 dB or 30 dB?) If you can identify the culprit, start with that piece of equipment.

13. If you have an AC hum/buzz problem and are not running anything from AC, make sure it’s not sneaking in somehow. Are you using an AC-powered worklight whose metal parts are touching your cart? Have you left a cart battery charger connected? Have a plugged-in electric drill on a lower shelf? If you unplugged a feed from video assist, is the metal shell of the plug still touching something metal on your cart?
14. If you are running on AC, is everything plugged in to the same outlet? A surge-protected outlet strip is a good start. Is there continuity for the third (grounding) pin all the way to the power source, including any extension cords? Is the third pin receptacle in the wall outlet properly grounded? (Using an AC voltmeter, measure the voltage from it to a known ground. Cold-water pipes are good, unless plastic water pipes are involved.)
15. If nothing specific is indicated, perform a general check.
16. Are all interconnecting cables firmly seated? If they are twist-lock types, are they secure?
17. Wiggle each end of each cable at the juncture with the plug to see if that affects the problem. Cables usually fail at the strain relief, and the shield often fails first.
18. Loosen the cable clamps and separate all the cables in the bundle.
19. Isolate the power source of each piece of equipment in turn. Run it from a separate battery or AC supply.
20. Make a ground jumper from a length of 10-12 gauge stranded hookup wire, and connect one end to a solid ground point on your cart. Touch the other end to every connector shell, equipment housing, metal portion of the cart, etc.
21. It may help to make a sketch of your setup and look for unexpected current paths. Remember that any current flow will produce a voltage “drop” that, in fact, raises the voltage at the far end with respect to “ground,” and this voltage will look for any way possible to get there.

## SAFETY CONSIDERATIONS: SAFETY FIRST, LAST, AND IN BETWEEN

If you connect AC power to your cart, there are several precautions you can take.

1. Only connect to 3-prong grounding-type outlets, and check them beforehand with a plug-in 3-lamp tester to make sure they are wired correctly and properly grounded. NOTE: These simple testers are quick and easy to use, and will unambiguously indicate the presence of a connection to the safety ground socket. What it cannot distinguish is whether the connection is properly to the ground wire or incorrectly to the neutral. While either will provide the necessary safety shunt in the event of a powerline short to a 3-wire “grounded” equipment housing, the wiring reversal can cause massive AC ground loop problems.

**WARNING: 2-wire power cords have “polarized” plugs, with one blade (the neutral) slightly wider than the other (the hot phase). Modern receptacles, whether 2- or 3-prong, have one slot wider to match, but older 2-prong outlets have both slots narrow. Some individuals have been known to file, saw, or cut down polarized plugs so they will fit these older outlets, and either way in the newer ones. Applying the hot phase to the neutral side of any**

**device is never a good idea, even if the housing is plastic and/or “double-insulated.”**

**ANOTHER WARNING: If you absolutely must use a 3-to-2 adapter, be sure the grounding lug or pigtail lead is connected to the screw between the two outlets, and then check with the tester, because in some locations the receptacle mounting box is not grounded. Be very afraid if this is the case—run a 3-wire extension cord to a known good (tested) outlet.**

2. Use only 3-wire extension cords, and check them at the far end with the tester. WARNING: On a non-union show I was given an extension cord by the electric department. It had a 3-prong plug and receptacle, but failed the test. I opened the plug to see if the ground wire was disconnected, and found to my horror that the electricians had made all their “3-wire” extension cords with 2-wire cable because it was cheaper and lighter.
3. You can buy a plug-in G.F.I. (Ground Fault Interrupter, also G.F.C.I.), and this is particularly important if you are working outdoors or on a damp concrete floor. In addition to providing overcurrent protection like an ordinary circuit breaker, it senses any current differences between the current going out on the hot wire and returning on the neutral. If there is more than a 5 mA difference (such as current flowing through your body to ground instead of the neutral wire), the unit shuts off the power. 5 mA will give you a nasty shock, but (hopefully) not induce ventricular fibrillation in your heart. WARNING: G.F.I. receptacles have *TEST* and *RESET* buttons. Test them every time before use. IMPORTANT: Some G.F.I. units will trip if there is an interruption in the AC power supplied to them, so they cannot be used on the camera truck for overnight battery charging if the truck will not be plugged in until it is driven somewhere or if the AC supply to the truck is disconnected when it is moved during the night. (NOTE: This is also true of some “automatic” battery chargers.)
4. You can buy an AC power 1:1 isolation transformer in various sizes, from 100 W to 1 KW or more. If you need to run on AC during the day, and are working in damp or exterior locations, this will isolate the power sent to your cart completely from ground, so in the event of a leakage problem, what would have been a fatal shock will be only a tingle. You can feel a tingle from less than one-thousandth of an amp (< 1 mA). WARNING: “Tingles” of any sort are a warning sign that must not be ignored. Locate the problem and fix it before you or someone else is electrocuted.

**ANOTHER WARNING: Stepdown “transformers” used to lower foreign 220 V AC power to 110 V are often not *true transformers* with separate**

primary and secondary windings, but rather *autotransformers* with a single, center-tapped winding. While these units will halve the voltage, they do not provide any isolation, and the full 220 V may appear in the event of an internal short, including to the case. Many of them do not provide proper grounding through the third pin as well. With the unit disconnected from both AC power and 110 V equipment, use an ohmmeter to check for continuity between any of the output terminals and any of the input terminals. If there is none, you have a true transformer and not an autotransformer. Also check that there is continuity between the input and output ground terminals.

5. Always plug all your AC power cords into a single outlet (or both outlets of one duplex receptacle), unless the total current draw would overload the circuit. Most sound gear (except for things like playback amps) requires very little current, so using cube taps is acceptable. (I have extension cords that terminate in duplex outlet boxes, providing six heavy-duty 3-prong receptacles.) There are two reasons for this practice: 1, all the safety grounds will interconnect at just one point, avoiding power source ground loops from different ground potentials; and 2, in the U.S., consumer 110-V power is usually distributed as 3-wire 2-phase 220-volts. While the 2-phase wires are 110 volts with respect to the common neutral wire, there is twice that voltage between them. A typical building’s internal wiring has half the branch circuits supplied by one phase and half from the other. If you happen to power some of your gear from one branch and the rest of it from another branch fed by the opposite phase, their hot 110-V power conductors will have a 220-V differ-

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ence. This increases: the chance of fireworks if there is an error in your cart's internal AC power wiring; the potential severity of a shock from leakage between two pieces of equipment, particularly with those having 2-wire power cords; and amount of AC hum and buzz that can be induced in audio circuits.

6. When using AC outlets provided by the electric department, especially when supplied from a generator, there is another potential danger. The outlets boxes are connected with runs of 4-0 heavy cables that use color-coded pin connectors. In the event that there is a mis-wiring, 220 volts (or 208 V for 3-phase) can appear on the "110-V" outlets. Even if the cables are connected correctly, if the neutral wire becomes disconnected anywhere between the load and the generator, all the loads connected to one phase will be connected in series with all the loads connected to the other phase, with the result that the full voltage will be applied to the combination. Unless both total phase loads happen to be exactly equal (unlikely), the greater load group will get less than 110 volts and the smaller load group more than 110 volts. Sometimes a lot more.

### If you use external batteries to power your equipment, there are different precautions to take.

1. WARNING: Batteries, even small ones like alkaline AA cells, can produce surprisingly large short-circuit currents. A shorted battery can get hot enough to melt plastic, and may rupture and spray corrosive chemicals all over. Short-circuit currents (often over 100 A) can heat wiring to incandescence and start fires. SLA (Sealed Lead-Acid) batteries are especially dangerous. If you don't want your cart to disintegrate in a shower of sparks like things do in the movies (think *Star Trek*, where they never invented fuses or circuit breakers ... or seat belts either), you need to fuse each battery directly at its terminals. Auto parts stores sell in-line fuse holders that are ideal

for this purpose. A 20 Amp mini-blade fuse is a good choice for a small battery (30 Amp-Hours or less). If you use a larger battery, get a fuse that is rated for 2-3 times the maximum current draw of all your equipment.

2. WARNING: Unlike AC current, which passes through zero twice every cycle, DC current is much harder to interrupt. If you wire up your own cart (or have someone else do so), be sure to use fuses or circuit breakers specifically rated for DC. (Typical 5 Amp 3AG/AGC glass fuses are rated 110 VAC but only 32 VDC, so check your selections carefully.) Automotive fuses are all designed for at least 12 VDC. They should still function properly at 15 VDC or 18 VDC, but 48 VDC may be too much for them. Many years ago, when stages and theaters still had wall outlets with 110 V DC, a mixer (not me) mistakenly plugged his cart into one. The current continued to arc through all the blown AC fuses and melted down much of his equipment before the smoking power cord was yanked from the wall.

3. The "hot" center contact of many coaxial low-voltage DC power connectors is flush with the end of the plug, and can short out to grounded metal surfaces if the plug brushes against them. I have installed in-line fuse holders in each of these power cords, with readily accessible 5 A fuses (rated less than the 20 A main fuses so only that particular branch fuse will blow).

4. Many fuses have a "time" rating as well as a current one. Fast (usually marked "F") fuses provide the maximum protection, but may blow unnecessarily with loads that draw a larger initial current. Motors and incandescent lamps are prime offenders. *Delay* or *Slo-Blo* (marked "T" for time-delay) fuses can carry current in excess of their rating for a short time and should be used for these applications. Unfortunately, modern microelectronics can be damaged by current pulses too brief to be stopped by conventional fuses. Tiny Micro- and Pico-Fuses, which look somewhat like 1/8-watt resistors, are usually soldered directly to the circuit board because they are designed to limit the spread of damage rather than prevent it. If you happen to have a piece of equipment that uses these, and they do occasionally blow without any other damage, you can avoid unsoldering them and soldering in replacements by installing two single-lead sockets on the circuit board and then simply plugging in the fuse's wire leads.

5. Another new fuse type is the "thermal fuse." These fuses will open above their rated current like a regular fuse, but they will also open if their temperature exceeds a certain value. They are designed to protect components such as motors, which can get too hot if they are overloaded for long periods. Some thermal fuses are *one-shot*, and must be replaced if they blow. This is difficult because not only are they soldered in, but they have to be located next to the motor's windings where they can sense the temperature. Twelve-volt air compressors (used to inflate sound cart tires) are a good example. If you have to replace one of these fuses, you can get an equivalent unit that is *self-resetting*, and it will automatically restore the connection after it cools down.

### CODA

In closing, let me warn you that the goat's blood trick that works so well with radio mikes is useless for ground loop problems. You need blood from a cute little puppy or kitten.

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My lightweight rig—running on batteries. Four sharkfins feed a 4-pac and 6-pac of Zaxcom receivers connected to a Fusion-12. A fifth feeds my video monitor. The only two cables send an audio mix to the Codex recorders and receive playback audio from a video display image appearing in the shot.

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