

## What Radio Broadcasting Taught Me About Recording

#17

I'm Doug Fearn and this is My Take On Music Recording

It was the Christmas break during my senior year in high school. The year was 1965, and I walked in the door of about fifteen radio stations in Philadelphia, looking for a summer job as an engineer.

You probably need a little background on radio at this time to see how a job like this was a possibility.

From its inception in the 1920s, through at least the 1960s, radio stations produced programs through a collaboration between engineers and "air talent." At least that was the case in the major markets.

At that time, a licensed operator had to be on duty, and that required a First Class Radiotelephone license. This was a relatively difficult license to obtain. It required taking a lengthy written test at the office of the Federal Communications Commission, or FCC. I had this license.

One of the stations where I applied was WPEN. It was not the most powerful station in Philadelphia, nor did it have the highest ratings. But it was a solid performer with a dedicated audience. The main outlet was the AM station, but WPEN also had a powerful FM signal, although mostly it just duplicated the AM programming.

It did not have a TV affiliate, as several of the other stations did, but the radio studios were a throwback to the golden age of radio – pre-TV.

At each of the stations where I applied, I asked for a tour of the facilities. In every case, the director of engineering, or his assistant, spent time talking to me and giving me a tour.

The WPEN studio complex at 22<sup>nd</sup> and Walnut Streets was built in 1947 and was largely unchanged since then. RCA was the contractor for the facility, and much of the equipment was made by RCA. There was not a single transistor in the entire place. Everything was state-of-the art, post-World War 2 vacuum tube equipment.

Sure, Ampex tape machines were added when they became available in the early 1950s, and the station made use of tape cartridge machines for playing commercials. But otherwise, everything was old – and I thought it was beautiful.

When I sat down with the chief engineer that day, he listened to my story for a few minutes and then said, "I need someone right now. Can you start today?"

I was taken aback, and could only reply that I was still in high school and I just wanted a summer job. He then asked if I could work weekends until school was out. Of course I agreed.

All the other stations where I applied offered a summer job, but I had already decided I was going to work at WPEN. And I was going to start working in a few days.

But how was I possibly qualified to do this?

Well, my high school station in the Philadelphia suburbs had its own FM broadcast station, WHHS. In fact, it was the first high school station licensed by the FCC back in 1949. The station was run by the students and supervised by a faculty sponsor and an outside technical advisor.

The technical advisor, himself an alumnus from the early 1950s, worked at the CBS affiliated AM, FM, TV station in Philadelphia. He insisted that we run our 10-watt station as if it were a 50 kilowatt clear channel powerhouse. Like the big stations, we had engineers and air personnel. Our technical advisor forced us to be professional. We were all a bit scared of him, since he minced no words when he walked into the station and ran down a list of imperfections he heard.

That's where I learned how to wind microphone cables. We had some long cables – some as long as 100 feet, for use when we broadcast home and away sports events, or broadcast concerts by the school orchestra or band. The cables had to be wound perfectly, so they would uncoil without tangles. And properly wound cables protected the wire and connectors from damage. If a cable was not perfectly wound, our technical advisor would toss it down the school hallway and make us wind it again. And again. Until it met his specifications.

This is just one example of that standards he set for us.

WHHS was where I first learned about recording, which was a frustrating but exhilarating experience for me. Eventually I was asked to record my friends with their own rock bands.

We had excellent equipment at WHHS, including Ampex tape machines, a Collins console, GE transmitter, and a nice collection of RCA, Electro-Voice, and Shure microphones. Everything was vacuum tube. What we did not have was good acoustical environments for recording. Working in less-than-ideal rooms was also good experience.

But now I was ready for “real” radio. And WPEN was like a dream come true for me. It had a staff of 13 engineers, 11 studios and control rooms, and a wide variety of programming.

Throughout the day, programs came from 6 different studios and control rooms. Five other rooms were reserved for production.

One studio occupied the entire first floor of the building. It was the room where the predecessor of American Bandstand came from, before it moved to TV. When I was there, it was a live audience studio for the late-night talk shows. It had an elevated control room that overlooked the studio. That studio was huge, capable of seating a couple of hundred people, and it had a 25-foot ceiling.

All of the other studios were on the third floor. The second floor, along with the adjacent building, were home to the offices.

During the day, most of the programming came from the Master Control Room. This was a large room, about 30 by 20 feet, with soundproof windows on all four walls. Two of the windows looked out into hallways, but additional studios were across the hall and easily seen. The other two windows were into air studios.

The one straight in front of the console was Studio B, the second largest room in the station. At one time, it had a grand piano and a Hammond organ, which were used for live musical performances. By the time I got there, the instruments were gone and the studio cut in half, making room for offices for the air staff.

Still, the room was about 30 by 25 feet, with a 12-foot ceiling.

All the studios had walls acoustically-treated with Transite, a tile made from cement and asbestos and perforated with many holes. Behind the Transite was sound-absorbing material, which I hope was not asbestos, but it probably was. Transite was used throughout the building, for all the studios and control rooms, and even in the hallways. It was on the ceiling, too.

It gave all the rooms excellent acoustics. Transite was a common material in recording studios, going back to the 1930s. It is still in use in some recording studios where I have done sessions in recent years.

In fact, radio stations and recording studios were quite similar in construction during this era.

And the working dynamics were similar, too.

In radio, the engineer was the de facto producer of the radio program. The announcer provided the performance talent. The engineer was in the control room with all the equipment, and the announcer was in the studio. When I started at WPEN, it had only recently allowed the announcers to control their microphone on-off switch.

This is not to diminish the contribution of the air talent. They were the public “voice” of the radio station and they were celebrities. Their creativity captured the audience and made the station successful.

But the engineer made it all work. Engineers made the air talent look good, and took the burden of the mechanics of making the show off of them.

But what, exactly, did the engineer do?

Some programs were mostly music. And commercials. The music came from vinyl records, which were played on Fairchild turntables with a 16-inch platter. Yes, Fairchild made turntables as well as compressors.

Those old turntables took several revolutions to come up to speed and stabilize, so it was necessary to cue the audio to the start and then hold the record by hand on the felt-covered turntable. When the proper time came, you released the record and brought up the pot. Sounds easy, and it isn't difficult, but getting the timing right so the music started at a natural rhythm following the preceding audio required a good ear and coordination. It's subtle, but when done properly, the flow feels natural and the mechanics disappear.

Some engineers were very good at this and others were not. Like everything else, it's a talent that you either develop or you don't. Some people can't even tell the difference, but it does make a difference in how the program flow makes the listener feel.

The same sense of rhythm applies to all the programming elements. The commercials were played from tape cartridges, which consisted of a quarter-inch tape housed as a continuous loop inside a plastic housing. The cartridge was inserted into a cartridge machine and started with a front panel button.

There was an art to transferring the audio to the tape cartridge. The system ran at seven-and-a-half inches per second, and used a 1 kHz tone on a separate track to stop the tape when it got back to the beginning. The timing during the transfer from a disc or reel-to-reel tape had to be right or there would be either a too-long pause before the audio, or the first audio might be mangled if it was too tight. Consistent timing was necessary to make sure the audio appeared just when you wanted it, taking into account a certain time delay. The delay was short – milliseconds, really – but it could mess up your timing if the cartridge wasn't recorded properly. I used to put little marks on the label on the cartridge to indicate if the timing was sub-optimum.

The station carried a lot of news. It was both an NBC radio network affiliate and also Mutual Broadcasting System. We carried NBC news on the hour, followed by a 5-minute local newscast, and then Mutual news on the half hour. There was a full hour of news at 6PM, from various sources.

Those newscasts, and other network programming, came at precise times, so making a smooth transition from local to network programs required some skill.

One thing I learned from the other engineers was how to use the face of an analog clock as a sort-of slide rule, to add and subtract times. You mentally moved the hands as needed to calculate times. Once you got good at it, you could calculate the duration of several sequential program elements with good precision, to make everything come out just right to meet the network.

I learned a lot from the old engineers at WPEN. I was the first new hire there since 1949, and everyone else was two or three times my age. Some of the staff went back to the day when the station went on the air in 1926.

Even as a kid, I was fascinated with the history of technology. And now I was working with people who invented radio. They were quickly annoyed at my constant questions.

The studios were downtown, but the AM transmitter was several miles to the west. When that transmitter site was built in 1936, it was farmland. By the time I got there it was solidly built out in houses and shopping centers. The old guys would tell me about sitting on the front porch of the brick transmitter building and shooting rabbits and other wildlife.

The transmitter was the repository for a lot of the station historical files. I was assigned to the studio most of the time, but when I was at the transmitter, I would spend time going through the files and get a sense of the history of the technological changes over the 40 years since the station started.

The transmitter site was also interesting because of all the high-powered transmitters and peripheral equipment. There were two transmitters – an old Westinghouse giant that took up an entire wall, with the power supply in another room. The power supply looked like something from an electrical distribution yard, with big transformers, huge capacitors, and giant violet-glowing mercury vapor rectifier tubes a couple of feet tall.

The 1936 Westinghouse transmitter was relegated to backup service. The main transmitter was a late 1950s RCA unit, about one-quarter the size.

On-air audio processing was in two stages. At the studio we had a CBS Audimax, a sophisticated compressor for its day that handled a wide variety of audio very well. At the transmitter, an RCA BA-6 limiter ensured that the transmitter was not overmodulated, which would result in extreme distortion or even damage to the transmitter. Also in line was a device that corrected for waveform asymmetry. An asymmetrical waveform, which is common in a lot of voices and music, would reduce the apparent loudness of the broadcast. This clever device corrected that.

Back in those days, the FCC required a licensed engineer on duty at all times. On the top of the hour and every half hour we logged multiple meter readings and operating status in a large bound log book.

The FCC also required that all transmitter sites were habitable for days on end, in case of an emergency. The building had a large kitchen, a bedroom, and enough supplies to keep an engineer going for a week or two.

The station changed its directional pattern at night, so every morning and every evening, as the sun rose or set, the pattern had to be switched. This was coordinated with the studio engineer over a dedicated telephone connection. The in-house telephone system actually connected all the studios and both the AM and FM transmitter sites. It ran on large dry cell batteries and had a hand crank for ringing, like you might see in an old movie. It was crude, but totally reliable.

The FM transmitter site was on the top of a building in center-city Philadelphia, a few blocks from the studios. It was one of the first transmitters licensed to be controlled remotely, and the remote-control point was at the AM transmitter site. Every day, a licensed operator had to inspect the facility and verify that the remote meter readings were properly calibrated. I enjoyed that walk to the FM transmitter, which was in a penthouse on the roof of the building and it would have been a prime luxury residence. It was newer and nicer than the AM site. It was also much larger. The view out the many windows was spectacular.

All the audio to and from the transmitter sites ran through dedicated broadcast-quality telephone lines, which were flat from at least 50Hz to 15kHz, within 1dB, and had a noise floor no higher than -60dB. AM broadcasting is capable of true high-fidelity, and WPEN broadcast extremely clean and wideband audio. Unfortunately, as manmade electrical noise increased over the years, radio receiver manufacturers responded by narrowing the bandwidth of the receivers until they had audio response only to around 2.5kHz. The noise is even worse today, which is why what little AM broadcasting is left is mostly just talk radio. It's a shame, because back in the 1960s and prior, AM radio sounded excellent – especially with the all vacuum-tube electronics.

As in any business, some of the engineers and announcers were just there to do their shift and get paid. That was depressing to me. But there were others I worked with who had a passion for radio and wanted to use the medium to its fullest extent. Back then, air talent had a lot of freedom to make the kind of radio they wanted – within reason, of course. I enjoyed working with the dedicated people there, and tried my best to help them with their program.

The very first program I engineered, on that first weekend, was with Ken Carson, a talented musician who was a member of the Sons of the Pioneers, a popular singing group that performed western style music. They were noted for their part in the Roy Rogers western movies, as well as their concerts and records.

Ken was a fascinating guy, who had been performing since the early 1930s. He put together a great show of classic western music, along with some country music, and told stories about the songs and his experiences.

He also brought his Martin D45 acoustic guitar and sang on almost every show.

Most of the engineers paid little attention to this, just using his announce mic to pick up whatever guitar it could. I wasn't happy with that and Ken and I experimented with different mics and mic'ing arrangements until we found something that made him sound really good. The excellent acoustics of the big studio B helped, too, and I moved him to a different spot each show, until we found the best place in the room.

His decades of recording experience helped guide my learning about what works and what doesn't.

The big studio A, with the audience was fun, too. The guests covered anyone of note, from politicians and newsmakers, to book authors, musicians, actors, and comedians. It was great fun, and although I wasn't always interested in the some of the guests, the musicians were something I looked forward to.

The station played what was called "Middle of the Road" music at that time, which relied heavily on performers like Frank Sinatra, Ella Fitzgerald, Louis Armstrong, and Peggy Lee. All of them were on the show at one time or another, but usually we just played their records and they did not perform live.

However, some of the 1960s up-and-coming singer-songwriters were also on the show, and I got to work with many of them. One that sticks in my mind was Frank Zappa. I'm sure the show host had no idea who he was or what he did, and even if they did listen to his music, it made little sense to them. The first time he was on the show, he came up to the elevated control room and handed me an LP. He apologized that the album did not have individual bands for each song, and he said he would help me find where to start. I think he was amazed when I told him I knew that album and I found the song right away.

Our paths crossed several times over the years, even long after my radio career, and we always had interesting conversations.

One air personality, who I will call Bill, had an afternoon show every weekday. He and I got along great. There was a certain common sensibility that we shared, and we really had very little to coordinate during the program since we both knew how a certain segment would work without discussing it much. We also shared a somewhat odd sense of humor.

One beautiful Spring day, Bill casually mentioned on the air how great it would be if he could do his show outside in the nice weather. Well, the station was in the middle of the city and there wasn't any practical way to do that, but later that day I told him I would come up with something for tomorrow's show that might help with the illusion of being outside.

I stayed late that night in the main production control room. It was fairly well equipped, with three Ampex mono tape machines, two turntables, three tape cartridge machines, and some rack gear, including a couple of Pultec equalizers and Fairchild and RCA limiters. It even had a tape echo reverb machine with multiple heads.

From back in the days of live radio drama programming, the station had an extensive collection of sound effects records. These were 78s, and I found them stashed away in a huge cabinet in the back of one of the studios.

I put together a sequence of sounds to create the illusion that the roof of the studio was capable of being rolled back to open the room to the sunshine. To make the sound of this massive machinery, I used an old wooden office chair that creaked and squeaked as it was rolled over the tile floor in the hallway outside the production studio. I recorded that with several mics, each feeding a different Ampex tape machine running at 15 ips. When I slowed the tape down to 7.5 ips, the chair sounded like huge machinery, but it wasn't quite complete. Another generation through the Ampexes and I had it slowed down to quarter speed and it sounded great. I also mixed in some of the other tracks at various speeds.

The sequence opened with a solid clunk and some whirring sounds as the massive roof slowly rolled back. As the roof opened, I slowly brought up a 1930s recording of a calliope playing "In the Good Old Summertime," along with birds chirping. As the roof reached its maximum opening, the music and the birds peaked.

For the closing, I simply faded the sounds down as the machinery closed the roof, until, with a solid clunk, everything was silent again.

The next afternoon, I played the two recordings for Bill and we formulated the plan. He told the audience that I had found that the studio ceiling could be opened, but had not been used that way in many years. He told the listeners he was going to open the roof and enjoy the beautiful spring day. Bill basked in the sunshine, telling the listening audience how pleasant it was.

But the most amazing part to me was when people from the second-floor offices started running up the stairs to the third floor, anxious to see this roof they never knew about.

That showed me the power of sound to create an illusion that was so compelling that people were willing to suspend their logic and believe that a sliding studio roof really was possible.

We used the roof recording a couple of times after that, but we knew it had to be rare and unexpected to be effective.

I made a version with an approaching thunderstorm, which rapidly intensified and brought heavy rain. The 1930s sound effects were perfect for this. The sounds were not recorded in nature, but created in a studio using physical objects like metal sheets and water pouring on a stone table. Heard by themselves, they were cartoon sounds. But used in the right context, they were more believable than a recording of a real thunderstorm.

Bill completed the illusion by pretending to mop up the soaked studio, using a tray of water and a sponge. He did that part live, with a mic I placed for the pickup.

We did many more of these sound illusions over the next couple of years.

The production studio was fascinating to me, especially the disc-cutting lathe. When the station was built, there were no tape machines. Anything recorded had to be on disc. Even when I was there, the station sign-on and sign-off announcements were on lacquer discs. Many of the commercials that came from advertising agencies were also on lacquer discs.

I studied the lathe whenever I had a chance, and figured out how it worked. Well, mostly. A lot of it was mysterious to me.

I asked some of the engineers to show me how to use it, but they declined. They saw it as an obsolete piece of junk that was only there because it was too big and heavy to throw in the trash.

So, I decided I would learn how to use it on my own, by trial and error. Mostly error, as it turned out. I found a supplier of lacquer discs on Long Island, and another specialty firm that made the sapphire cutting styli. These were not cheap, but I suspected that learning how to cut discs might be useful someday.

I plan to do a show on cutting lacquer discs sometime in the future. Most of my early knowledge was derived from using that old lathe at WPEN.

The equipment at the station was very reliable. I don't recall ever having an on-air failure of any critical equipment. That was largely due to having quality equipment and excellent preventive maintenance.

There was one engineer at the studios whose job was entirely maintenance. There was another engineer who handled the same tasks for the transmitter sites.

When the station needed some sort of custom electronics device, it was designed and built by the maintenance engineers. There was a huge shop in the basement with all the tools, large and small, plus all the parts, that you would ever need. There was a similar shop at the AM transmitter site. I used those shops to build a lot of custom stuff for the station, as well as some of my own equipment.

I already had lots of experience building and repairing equipment on my own, going back to when I was about seven years old. But there was a lot more I learned from those experts.

During one of the rare occasions when I had a shift at the AM transmitter site, a violent thunderstorm moved in over the towers. Lightning was hitting all around, and the three towers were hit often. The noise was overwhelming, and the flashes were disorienting. I spent about fifteen minutes with my hands over my ears, standing in the middle of the room, as far away from any equipment as I could get.

One lightning bolt vaporized the inside of one of the meters used to monitor the current fed to one tower. The metallic vapor deposited on the inside of the glass face of the meter, instantly turning it into a mirror. Seconds later, a second meter was also vaporized.

Flashes of electricity arced around the corners of the room, and caused some of the neon indicator bulbs on the equipment to glow much brighter and pulsate. It was fascinating and terrifying at the same time.



Eventually the storm passed away to the East and the sun came out. Miraculously, the station stayed on the air through this. But it was obvious that at least one of the two outer towers had sustained damage to components that were housed in a small building at the base of each tower. During the day, only the center tower was used, and it seemed to be OK, although I couldn't be entirely sure without functioning meters.

I was still shaking when the chief engineer drove up shortly after the storm had passed. I wondered how many of these events he had been through, and judging by his calm approach to the repairs, I concluded that this was nothing new for him.

We determined that the West tower components were probably OK, but the East tower was a different story. When we opened up the door to the building at the base of the tower, it was filled with the debris from exploded components.

The sun was setting in another hour, and even though there was still thunder rumbling in the distance, we worked to restore the tower before the pattern change at sunset. Most of the damage was to gigantic capacitors about the size of a basketball. They were made from heavy ceramic, with massive metal end plates where they were bolted into place. The value of the capacitor was critical, and an improper value would not work. We went through a large collection of spare capacitors in the shop, but none were precisely what we needed. We had to improvise using several individual capacitors in series and in parallel, and then figure out how to make the assembly fit in the available space.

We did it, and went back to the transmitter building with only minutes to spare before the required switch. The chief engineer stood watching as I went through the sequence of turning off the transmitter, pushing the switches that engaged huge relays to re-configure the towers, and then hit the switch to put the transmitter back on the air. This took only a second or two, but I held my breath as I listened for the proper sounds from all the big relays involved.

It worked! We knew it was not perfect, and we could not monitor the parameters until the blown-up meters were replaced, but the station was on the air and legal.

Not all maintenance was that dramatic. One of my first assignments was to repair an Ampex tape machine that needed a new bearing in a weighted idler wheel. This seemed simple enough. Those machines were easy to work on and designed to be simple to repair.

The problem was that I was supposed to do this work after the station signed off at 2AM and I was the only person in the building. And the Ampex machine was in a rack in the Master Control Room that was built into the wall. The back of the rack was only accessible from the hallway.

How could I remove this 70-pound tape transport from the rack and arrange it so I could work on it?

I studied the problem during the earlier part of my shift and decided the best approach was to use a wheeled cart to support the machine once it was free of the rack. But how would I suspend the weight while taking out the rack screws?

A tape transport is a precision mechanical device and it was not permissible to put any stress on any of the components, above or below the deck.

I found some chain, hooks, and clamps and rigged up a way to transfer the weight from the rack to the chains that would not endanger any of the mechanism.

The actual repair was quite quick, and I reversed the process to put the machine back in the rack.

Throughout my life, it's been rare that I had someone one around when it came time to move heavy things, and my experiences doing maintenance at WPEN taught me how to do this stuff on my own.

All these experiences proved valuable.

And, yes, I had planned to stay at WPEN only for the summer, but I ended up there for six years.

Even when I was in high school, I knew that I wanted to have my own recording studio and make records. It was the 1960s and every day there was new music that grabbed you because it was like nothing else you had ever heard before. I wanted to do that.

But building a studio back then was a huge investment. Tape machines were only made by a couple of manufacturers, and they were very expensive.

There were no consoles like we know today. Studios either used repurposed broadcast consoles or built their own. I took the latter course, using tube mic preamps I acquired from many sources, including some from WPEN that were no longer needed.

Back then, you had to be 21 to do most anything. You had to be 21 to rent an apartment, or arrange for a telephone or electrical service. You had to be 21 to sign a contract. And you had to be 21 to legally start a business.

So, I used my time at WPEN to save up the money I needed, while waiting until I was 21, and I acquired a lot of nice equipment along the way, including a couple of Ampex tape machines, Neumann mics, and I bought several RCA ribbon mics from WPEN since they no longer saw a need for them.

During this time, I did location recording, lugging all that heavy gear to various auditoriums and concert halls.

I was lucky to work in radio when it was still a highly-creative and successful source of entertainment. Television was taking over the home entertainment world, but in radio, one person in a production studio with some sound effects records and a vision of what they wanted to make could create an illusion that would be far too expensive to do on television.

And radio paid very well back then. I started working weekends as a high school kid making the equivalent of about 100,000 dollars a year in today's money. I could fill my car with gas and buy lunch for a week with just a ten-dollar bill.

I saved every penny I could and a few days after my 21<sup>st</sup> birthday, my company was incorporated. I had already lined up the building to rent, and I had most of the equipment I needed to open my studio.

The studio started with an Ampex half-inch four track, along with Ampex and Scully stereo and mono machines. I built the mixer. I found mics that I liked and gradually built up a mic collection.

Friends helped me construct the studio, sometimes in exchange for recording time or for a place to stay in the upstairs apartment.

I continued to work at WPEN for a couple of years, not quite sure I could make it on my own. But business came in, and the studio was soon profitable. I have not worked for anyone else ever since.

That experience working at WPEN was important to my career. I learned about recording there, and equipment maintenance, and working collaboratively with creative people. I met a lot of celebrities and learned that when you work with them as a professional, they usually treat you with respect and are grateful that you want them to sound their best.

This was great preparation for my career in recording. The exposure to the sound of high-quality vacuum tube equipment convinced me that tubes and audio belong together.

This is My Take on Music Recording. I'm Doug Fearn. See you next time.