INSIDE: TEST EQUIPMENT BASICS

SOUND & COMMUNICATIONS

FOR CONTRACTORS, SYSTEM MANAGERS AND SPECIFIERS MAY 1988

THIRD ANNUAL SURVEY OF THE CONTRACTING BUSINESS

HOW TO GET CLOSE AND STILL KEEP YOUR DISTANCE.

For any application that demands fidelity *and* invisibility at the same time, our new line of CK-X condenser capsules is ideal. Their high-quality F.E.T. circuitry and specially shielded triaxial cables mean that capsule and pre-amp can be separated by as much as *200 feet* without signal degradation or noise. Add in a complete range of mounting adapters, suitable for any mono or stereo technique, and you can cope with anything, from church choir to podium to fishpole.

The AKG CK-X Series gives you that big microphone sound in a small, easy-to-conceal package; *no more trading off quality for size.* And with cardioid, hypercardioid, omni and 4.2 ounce short shotgun versions, there's a capsule that's right for any application.

AKG acoustics

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SOUND & COMMUNICATIONS

Volume 34 #5

May 1988

COLUMNS

DEPARTMENTS

ON THE COVER

Our Third Annual Contracting Survey begins on page 33. We surveyed working contractors on their businesses — and found some surprises.

FEATURES

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THE PROS SAY A FEW WORDS ABOUT THE MANY COMPONENTS OF JBL.

High-quality components teamed up with results-oriented engineering. That's how JBL Professional helps the pros achieve superior sound for specific applications. Here's what JBL means to five leading professionals— all with vastly different requirements:

"JBL products are very reliable and efficient, and that's why we've used them for 16 years here at Abbey Road Studios. We have JBL equipment in many locations throughout the studios, and these products give us the sound uniformity we really need. We can count on JBL for professional, solid, great-sounding products."
Ken Townsend, General Manager
Abbey Road Studios, London, England

"In the concert sound business, we don't get any second chances. If the sound system doesn't perform, the audience can't come back next week when we've got it right. That's why we chose JBL. JBL products offer professional dependability and great sound—and that's how we define quality in our business. JBL really cares about making their products the best."
Roy Clair
Clair Brothers Audio

"You can't create a truly outstanding soundtrack without being able to hear everything accurately. That's why JBL's clarity was the first thing that impressed me. And with JBL, I can rest assured that our soundtrack will sound just as good in the theaters as it does in the studio."
John Bonner, Chief Engineer
Goldwyn Sound Department
Warner Hollywood Studios

"We first installed JBL equipment when we were selected as the boxing venue for the 1984 Olympics. Our P.A. system brings great consistency and clarity to all our sporting events, including wrestling, motor sports, track meets, and basketball. JBL components deliver outstanding sound regardless of your seating location or the size of the crowd."
Glenn Mon, Acting Director
Los Angeles Sports Arena

"We chose JBL equipment because of its great reliability and transparency. All the worshippers in our 7,000-seat sanctuary must be able to hear equally well. JBL horns accomplish this without coloration. The sound is very clear and natural no matter where you're sitting."
David Taylor, Director of Media
First Southern Baptist Church
Del City, Oklahoma

At JBL Professional, we believe that components should match your application, not the other way around. To hear more about what sound professionals see in us, contact your JBL Professional dealer.

JBL

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Circle 204 on Reader Response Card

Our Thanks to the Contractor

You will find in these pages our third annual survey of the contracting market. Once again, we express our appreciation to all the contractors who responded to our request for information on their businesses. We know it was time consuming, and we hope the results of our tabulation will be useful to everyone.

As a special note of thanks from us and from some of the manufacturers interested in supporting those contractors, we are presenting some rewards to our hard-working respondents. The results of a random drawing for receipt of some special products follows:

First: A pair of JBL Control 5 Monitors goes to Gene Pelland, Morefield Communications, Inc.

Second: A pair of Celestion Compact DL4 loudspeakers goes to Total Safety of New York, Inc.

Third: Shure's DC Series Phonograph Cartridges go to Paul Feeney, Norcom Telecommunications, Inc.; Phil Nelson, McClelland Sound, Inc.; and Electrocon in Santa Rosa, California.

Foruth: AKG's K250 Studio Monitor Headphones go to: William J. Ahern, Independence Communications, Inc.

Fifth: 10 free subscriptions to Sound & Communications go to Will Parry, Maryland Sound; Jim Webster, Business Communications Systems; L. Rober Darr, Federal Fire and Security; Peter Mena, Simplix; Robert Reddington; Randy Randolph, Randolph's Electronics; Barry Garrich, Trans Sierra Communications; Dale W. Hall, Ceitronics; Curtis Gray, AAA Alarm Systems; Jack Crane Fallon, Atlantic Coast Entertainment Systems.

Again, our thanks to all, and especially to the manufacturers who supported this market report. We trust the survey will be of use.

On another note, this company was saddened last year by the death of Richard Heyser. Dick was a friend, and his generosity, both of information and of his time, was greatly appreciated. His credentials in the sound and audio industry of course were without question, but we remember him as a singular person.

Because of that, we have been happy to offer to be a part, with the AES, of a special Richard C. Heyser Scholarship Loan Fund. Anyone wishing to get the major update of The PHD Program will be contributing in part to this fund. We have offered to be a conduit for the materials; and to facilitate the shipping of programs and collection of moneys. It's not a profit making venture for us, and that's in keeping with our feeling for Richard Heyser. If you'd like to contribute, and receive a program, send a check for $300 or more as a donation to the Richard C. Heyser Memorial Fund, c/o Sound and Communications, 25 Willowdale Avenue, Port Washington, New York 11050.

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Sound & Communications • Music & Sound Output
The Music & Sound Buyer's Guide • Post
NSCA-TV News • NAMM-TV News • CES-TV News
The Music & Sound Retailer
Home Entertainment

CETEC TO MERGE WITH MARK IV SUBSIDIARY

At press time, Mark IV Industries, Inc. and Cetec Corporation had announced that their respective Boards of Directors have approved a merger transaction in which a subsidiary of Mark IV will acquire Cetec at a cash price of $11 per share of Cetec common stock. It was unclear which subsidiary of Mark IV is involved. Electro-Voice, Altec Lansing and University are all affiliates of Mark IV. Their merger is subject to any required approval by stockholders of Cetec and "is subject to the satisfaction of certain customary conditions." Cetec has nine operating divisions.

This announcement apparently brings to an end plans for a leveraged buyout of Cetec by a private investment group for $10 per share, for which an agreement in principle had been announced.

Both announcements came in the midst of industry rumors of a planned sale of Cetec.

SONICS ASSOCIATES AND IMAX SYSTEMS JOIN FORCES

Imax Systems Corporation has acquired a 51 percent interest in Sonics Associates, Inc. Lynn McCroskey, president of Sonics, emphasizes that there will be no personnel changes for his Birmingham, Alabama-based company.

Imax, the inventor and developer of giant screen Imax and dome screen Omnimax motion picture systems, has recently added to its library "Heart Land," the first film to have digitally recorded Imax sound. Bill Breukelman, chairman of Imax Systems, said, "We want to solidify the breadth of services we offer our current and future customers—and to do the same for sound as we have done for picture. . . . Our extensive history of working closely with our colleagues at Sonics on more than 20 projects and in jointly developing proprietary technology made them our undisputed choice for a new partnership."

NEW MATERIAL FOR LOUDSPEAKERS

Neodymium is being used in speakers being produced by both JBL and Electro-Voice. JBL, which showed its neodymium compression driver Model 2450J at last fall's AES convention, will be shipping within the next month or so. Electro-Voice, which pioneered the use of neodymium in its N/Dym microphones, has its N/Dym 1 compression driver in production.

Both companies emphasize the advantage of greatly reduced weight through the use of this rare earth compound. As Paul Fidlin, EV group leader, loudspeaker components, says, "The N/Dym 1 weighs 7½ pounds and has a 5½-inch diameter. The comparable non-neodymium model weighs about 28 pounds and has an 8½-inch diameter."

The weight advantage, according to JBL, follows throughout the merchandising chain, from trucking through structural needs for the final sound system.

PERSONNEL MOVE TO WAVEFRAME

Several people well known to the audio community have joined WaveFrame Corporation, the Boulder based company that produces the AudioFrame Digital Audio Workstation "sound production environment."

Gus Skinas has been named product manager. Skinas was previously product manager, digital audio at Sony, and was with the Sony Professional Audio Division for seven years. Craig Hunter, previously sales manager for Everything Audio in Burbank, has been named Los Angeles branch office manager. Gary Rosen, who was Director of Sales and Marketing for TimeLine, and was previously with Sony, and the recipient of the 1986 Audio Engineering Society Board of Governor's Award, has been named New York branch office manager for WaveFrame.

In addition, John Eganhouses has been named sales representative in Los Angeles. He was previously manager of the keyboard department at West L.A. Music. Susan Sloatman has been named sales coordinator in Los Angeles. She was most recently sales coordinator for SSL. Liz Lockhart, sales coordinator in New York, was sales coordinator for SSL in New York. Doug Wood, applications engineer in Boulder, was the manager of Martin Audio's Music Technologies Division.

VIDEO PROJECTOR INSTALLATIONS

Installations of the JBL Professional 6810 video projector have been recently made for a variety of uses. Installations include one at the Smithsonian Institute, two at Lucasfilm, Ltd, three at Burbank Studios, one at Disney World Epcot Center, five at the University of Miami, seven at the University of Michigan, and one at Paramount Studios.

FANE ESTABLISHES U.S. SUBSIDIARY

Fane Acoustics Ltd., the British loudspeaker manufacturer, has formed its own Chicago-based subsidiary, Fane Acoustics Inc. The subsidiary is based in Des Plaines, Illinois, and will provide, according to the company, comprehensive warehousing of inventory. Fane is setting up a national sales network.

MUSIC SYSTEM INSTALLED AT ST. CABRINI HOSPITAL

The Health Services Division of AEI Music Network has installed a music system in the new Surgery Center of St. Cabrini Hospital of Seattle, Washington. The 21,000 square foot Surgery Center now has music in six pre-op, six operating and 12 post-operative rooms. Each of the 24 rooms carries four different music channels from which patients may choose.

Four AEI ProPac-4 cassette players have been rack-mounted with expansion chassis to allow for patient selection. Each hand control unit houses one headphone jack for Sony headphones.

According to a hospital spokesman, "There's a growing body of research suggesting music reduces stress in hospital environments." The operating rooms are additionally wired for a fifth, overhead channel which doctors and staff can program. This program provides an "audio curtain" between the practitioners and the patient—so that the patient can't hear what the doctors are saying. Musical choices include jazz, country, nostalgia, classical/new age.

dbx ACQUIRED BY CALIFORNIA COMPANY

At press time, dbx was expected to be formally sold to Carillon Technology, a California-based venture capital group. The sale gives dbx, with its pro and consumer brands, licensing, OEM, and BSR Japan to the venture capital group. Personnel at Carillon include Jacques Robinson and Alan Evelyn, both well known in the electronics market. According to sources, A. J. Menozzi has left dbx.

Model No.	Output @ 4 & 8 ohms	Stereo, Mono, Biamp or Triamp	Input Connector	Output Connector	Weight	Size	List Price
CROWN INTERNATIONAL							
Macro Tech 10,000	to order	Mono	XLR/Barrier	Barrier Strip	135	10.5" x 19" x 17.6"	$9,999.00
Macro Tech 2400	800W/525W	Stereo	XLR/1/4" Phone	5-way Binding	60	3.5" x 19" x 16"	1,899.00
PSA-2X	390W/265W	Stereo	1/4" Phone	5-way Binding	61	7" x 19" x 14.7"	1,795.00
Macro Tech 1200	465W/320W	Stereo	XLR/1/4" Phone	5-way Binding	48	3.5" x 19" x 16"	1,499.00
Macro Tech 600	325W/235W	Stereo	XLR/1/4" Phone	5-way Binding	43	3.5" x 19" x 16"	1,199.00
Micro Tech 1200	465W/320W	Stereo	1/4" Phone	5-way Binding	45	3.5" x 19" x 16"	1,199.00
Power Base 2	320W/320W	Stereo	1/4" Phone	5-way Binding	36	3.5" x 19" x 16"	1,049.00
DC300A II	295W/175W	Stereo	1/4" Phone	5-way Binding	45	7" x 19" x 9.7"	1,049.00
Micro Tech 600	325W/235W	Stereo	1/4" Phone	5-way Binding	41	3.5" x 19" x 16"	949.00
Power Base 1	200W/200W	Stereo	1/4" Phone	5-way Binding	34	3.5" x 19" x 16"	769.00
D-150A SII	150W/95W	Stereo	1/4" Phone	5-way Binding	27	5.2" x 19" x 8.7"	749.00
D-75	45W/35W	Stereo	XLR/1/4" Phone	5-way Binding	13	1.7" x 19" x 9"	524.00

CORRECTION:
Our Power Amplifier section of the March *Sound and Communications* issue mysteriously garbled the listing for Crown. Our apologies to Crown International—and to the fans of their amps. Here is the listing as it should have read.

The AES Heyser Scholarship Fund

The Richard C. Heyser Scholarship Loan Fund has been set up to honor Dick Heyser and in conjunction with this memorial, a major update of The PHD Program† will be dedicated to Dick Heyser and all the proceeds will go to the Richard C. Heyser Scholarship Loan Fund.

You may obtain a program for a donation of $300 or more; prior owners may upgrade for a donation of $50 or more. Make your check payable to the Richard C. Heyser Scholarship Loan Fund and send to *Sound & Communications*, 25 Willowdale Avenue, Port Washington, NY 11050.

† Trademark of Ambassador College.

As You Might Expect, No $700 Amplifier Has Ever Equalled The Performance, Quality And Reliability Of The $1000 BGW 7500...

Until Now!

Introducing The BGW 7500T. $1000 Performance At A $699 Price.

There are thousands of BGW 7500 amplifiers in the field today. In every case, our $1000 model 7500 was chosen over a number of lower priced alternatives, for its superior quality, durability and sonic performance.

But BGW knows that you don't always have the luxury of choosing the higher quality, higher priced amplifier. Until now, the price-sensitive buyer has had no choice but to settle for a less expensive, lesser performing unit.

Not anymore. Because BGW's new 7500T amplifier delivers exactly the same performance as our legendary model 7500, at a price that goes head-to-head with any U.S. or foreign competitor—just $699 professional list.

The model 7500T is a price/performance breakthrough. You get the same conservatively-rated 200/250 Watt-per-channel power (@ 8/4 ohms), the same performance specs—in fact the exact same amplifier design, circuitry and components as our no-compromise model 7500 — at a $300 savings.

How did we do it? We selectively trimmed a few of the model 7500's nice but non-essential frills. The 7500T has a steel front panel instead of a fancy aluminum one, and uses cost-effective barrier strip terminations. The 7500's LED indicators are omitted on the 7500T. The lower-priced model accommodates one optional BGW internal crossover card for biamp applications, while the 7500 can take two cards. These differences aside, our new economy model is a BGW model 7500 through-and-through.

Circle 215 on Reader Response Card

The 7500 and 7500T are the most rugged and reliable amplifiers you can buy. Inside, you'll find no trouble-prone relays and no sound-degrading IC's.

And here's an important difference between the 7500/7500T and other competitive units: Many use inexpensive MOSFET designs which require high bias, and consequently run very hot. Other brands use inadequate heat sinking. These competitive amplifiers can't live without forced air cooling.

BGW's exclusive copper header output devices don't require bias at all. We mount them directly on highly efficient heat sinks. As a result, the 7500 and 7500T run cool and efficient—so they don't require forced air cooling. And that means you can forget about replacing burned-out fans every few years.

BGW's 7500 has always been the ultimate choice for quality and dependability. Now that our 7500T gives you the same unmatched performance at just $699, there's really no reason to settle for anything less than BGW. Call us toll-free at 1-800-252-4800 (In CA, 213-973-8090) to arrange for a demo trial.

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INTERNATIONAL DISTRIBUTION OPPORTUNITIES now available in selected countries. For information, call BGW Systems 213-973-8090 or FAX 213-676-6713 by Ron Rosen

SEND ME A SALESMAN! (Part 2)

In Part 1 of this article we discussed the difficulty in finding available trained salespersons in our industry, and the possibility of retraining a person experienced in selling in an allied field.

As mentioned in Part 1, the term *salesman* is used in the strictest generic sense, and is in no way intended to exclude the many excellent female salespersons in our industry.

Long term relationships are not confined to affairs of the heart. It is not always easy to find that special "someone," and we would all like to have that person stay with us for years to come. Let us examine some obvious, but seldom stated facts:

Assuming you are an owner or manager, why are you in that position rather than that of a non-supervisory employee with steady hours, steady pay and fewer worries? It takes no crystal ball to assume that you are a self-motivated individual with a desire to make more money limited only by your own abilities, that you enjoy challenges and that you are willing to trade some security for potential.

If this sounds to you like a prescription for a salesman rather than an owner/manager, you are right. The point to be made is that the salesman is not so very different from you. Why offer a job that *you* would not be happy with? I submit that if you will mentally put yourself in that person's place, not only during the initial negotiations but throughout the term of his or her employment, you will have an excellent chance of creating that desired long-term relationship.

Keeping Them Happy. Happy is of course a relative term. Most of us will agree that in terms of a job, *happy* means contentment rather than absolute joy; whatever your definition is, let us stay with the term.

Please consider the following: A secretary, a technician or an installer may not be happy with their jobs, but are still able to perform their work in an acceptable manner. (Admittedly, not as well as when they are content; but nevertheless the work is still satisfactory, albeit done with a certain amount of complaining.)

A salesman, on the other hand, *cannot sell* if he is not motivated. If he is unhappy and is only staying with your company until something better comes up, it is better to come to an amicable parting of the ways as soon as possible for your mutual benefit.

What does it take to keep them happy without turning over the keys to the company? In the interest of negative imagery and with tongue in cheek, let us present:

**Ten Best Ways
To Lose A Salesman**

•Don't waste the time training him properly in your company's products. Arm him with catalogs and kick him out the door with the suggestion that he study at home.

•If the salesman does really well and is taking home a much larger paycheck than originally anticipated, ignore the fact that the company will eventually profit even more than he; change the commission structure.

•Don't bother with a well-defined marketing plan or territory. It is much simpler just to tell him to sell as much as he can, for as much as he can get.

•Don't bother to support him with advertising, direct mail, etc. It is far less expensive to have him knock on doors.

•Distribute leads according to customer potential, keeping the best ones for yourself. Keep established or lucrative accounts as "house accounts."

•When he comes to you with suggestions on how to increase market share based on conditions he is experiencing out in the field, give him no more than five minutes of your time and then immediately erase his suggestions from your mind.

•When he comes to you and tells you that he is being slaughtered by the competition, see the previous rule, but cut the time spent down to 2½ minutes. Who needs crybabies?

•Make the salesman account for every minute of his time during the day and make sure he checks into the office every morning at the same time as everyone else. If he has to work nights or weekends getting out a bid or attending a Board of Education meeting, that goes with the territory. He is making too much money anyway.

•Don't waste the time of your office staff with sales support. He is perfectly capable of doing his own paperwork, following jobs, searching for information, telephoning vendors, etc. Burden him with excess forms and reports.

•Don't hesitate to criticize when sales are down; criticism is easier than encouragement. Be stingy with praise when he does well.

The solutions are obvious, and most of us have been guilty of making one or more of these mistakes at one time or another. We will elaborate only on the first two rules—training and remuneration.

Training. With the exception of a person already well experienced in sales of sound and communication systems, proper training must be the single most critical determining factor in success or failure of a new salesman. It is surprising how many employers will invest considerable time and money in finding a suitable candidate, and then leave the job of training to whichever major manufacturer he represents, with the training either in the form of a factory training seminar or a visit from that factory's field representative.

The few days devoted to a factory seminar or the field rep's visit can only augment the in-house training and provide more detailed product knowledge. It is totally unfair to your manufacturer *and* your new salesperson to expect that person to be fed information, Cuisinart style, and in a few days emerge as the expert sound salesman!

It is essential that in the beginning the owner, sales manager or at least a senior salesman—compensated for his additional efforts, naturally—find *dedicated* time to spend with the newest member of the sales staff. Not

THIS GENERATION WILL BE WIRELESS.

What are *you* waiting for? With the introduction of our Stage II system, a limited budget won't hold you back. Samson world-class wireless technology means you can finally get the highest standard of audio quality and professional performance at truly affordable prices.

Stage II is the only system in its class with *dbx noise reduction. It captures the full dynamic and tonal range of instruments and vocals without the noise or coloration of typical compander systems.

Our ultra-reliable VHF technology, road-tested on the world's leading stages, fulfills the promise of no more dropouts and RF interference.

Before you know it, *everyone* will be going wireless. For the first time, Stage II lets you cut the cord and move freely into the wireless future.

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just a day, but days or even weeks, if necessary; preferably in the field away from the ringing telephones and other distractions. Your subsequent efforts in providing ongoing reviews, in-house new product familiarization sessions, travel to factory seminars and personal assistance when called upon will pay long-term dividends.

Remuneration. Money. The bottom line. The salesman's single greatest motivator. We would like to think that we are wonderful people to work for, our company is great and anyone would be proud to represent us; that our products and our service are the best. But let us be honest with ourselves—while all of these things may be true, the main reason that person works for your company is for the dollars he can take home each week.

A sound contractor faces certain unique problems when it comes to sales compensation. We do not sell single items at a fixed price, we primarily sell installed systems at varying profit margins. Assuming our salesmen are paid on a commission basis, either in whole or in part (salesmen paid on a fixed salary being in the minority), how do we properly compensate them without their salary (and our cash flow) going up and down like a roller-coaster?

If we pay them a percentage of the gross sale without regard to profit, we are being unfair to either them or ourselves, depending on the mark-up. If they sell into the construction market whereby a system could be sold for a building that is not even yet a hole in the ground, and our money is one to two years away, how can we pay the salesman? On the other hand, how can we make him wait? If we pay his commission based on profit, how do we know what that profit will actually be until the job is finished? Suppose he left something out of the estimate?

Most sales commission plans seem to fall into one of the following categories:

1. Fixed "base" plus small fixed percentage of gross sales.

2. Commission only—larger percentage of gross sales with a draw against commissions.

3. Fixed "base" plus varying percentage of gross sales according to profit margin.

Method 1, Base Salary Plus Percentage of Gross, has the obvious disadvantage of ignoring profit, which within preset limits set down by the company is usually under a salesman's control. There is another, less obvious disadvantage, however, to any combination of base plus commission that insidiously slows down many a salesman: Many employers do not realize that this type of plan can actually discourage a salesman from greater efforts, since his salary does not increase in proportion to the increased workload.

For an example, if we were to

(continued on page 66)

Ron Rosen is a freelance writer and has been both a contractor and district manager in the sound and communications industry.

COMMAND PERFORMANCE

The AD 13 Complete Digital Alignment System

PAINSTAKING DESIGN ensures the AD 13 has all of the functions and interface options to satisfy an extensive variety of system configurations. Utilizing National Semiconductor's new 16-bit HPC Series Micro-controller, the AD 13 provides up to 650ms delay on each of three outputs, with programmable 1ms or 20us steps.

READY TO WORK. There are no expensive options to order or configuration decisions to make. Use three separate buttons on the rear to select either transformer-coupled or active balanced/unbalanced outputs.

THREE-PIN CONNECTORS AND TERMINAL STRIPS are included for the input and all three outputs.

REAR PANEL LOCKOUT BUTTON and steel security cover protect your system alignment at all times.

EXCLUSIVE FAIL-SAFE BYPASS feature gives you comparison capability and automatic back-up protection from signal loss in case of failure or power loss.

EEPROM MEMORY BACK-UP: no batteries, ever.

Separate input and output level controls, LED metering, linear phase filters. . . the list of features goes on and on. Whatever the installations might require, cover your options with the most comprehensive delay package available: the AD 13.

RANE

Rane Corporation
10802-47th Ave. W. Everett, WA 98204
(206)355-6000

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BASIC PRINCIPLES

for Suspending Loudspeaker Systems

Attachments To Loudspeakers:

Bolts, shackles, clips and eye bolts all develop the greatest strength along their axes—vertical orientation in hanging applications. It follows that the safest location for hanging attachment points will be at the tops of cabinets to minimize angular stresses on hardware. This requires that the cabinet be strong enough to be safely hung from its top. Where multiple enclosures are needed, this can result in cabinets hanging from other cabinets. This makes the loudspeaker enclosure an integral part of the hanging hardware system.

A five-to-one design factor is generally assumed for hanging hardware. It follows that loudspeaker cabinets must be capable of similar design factors. With the exception of a half-dozen or so, few loudspeaker systems and components are load-rated and suitable for hanging without modification. The secure attachment of hanging hardware is no assurance that a cabinet will not pull apart under its own weight. *An unmodified cabinet will be no stronger than the material that it is made from and the joinery techniques used to assemble it.* As a general rule, all wood and wood-fiber loudspeaker systems over 50 pounds require structural reinforcement for hanging installation. There are many different methods of reinforcing cabinets that can provide acceptable safety margins, two of which are shown in Figure 12.

For plywood enclosures, hanging hardware is shown bolted to steel reinforcement plates that are securely attached to the cabinet in a steel-wood-steel sandwich configuration. One corner is shown. All load-bearing panel intersections should be similarly reinforced with steel plates. This reinforcement method is not suitable for wood fiber or particle board cabinets.

Particle board and wood fiber cabinets should be externally reinforced with continuous steel strap or welded steel channel secured to the box so as to completely surround the enclosure, capturing dadoed-in baffle and back panels. This reinforcement method is suitable for all types of cabinets. If the baffle board isn't dadoed into the side walls, the cabinet shouldn't be hung and an appropriate substitute found. *Never rely upon the internal bond strength of particle board or wood fiber cabinets to carry the weight of a large (over 50 pound) system.*

Small loudspeaker systems are subject to the same mounting considerations. Because they are small and

This article concludes a three part series, and is a reprint of "Basic Principles for Suspending Loudspeaker Systems," JBL Technical Notes Volume 1, Number 14—courtesy of JBL, Inc., Professional Division.

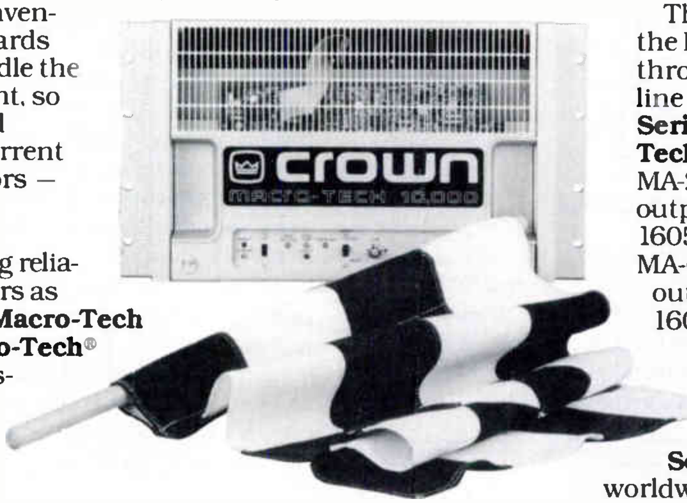
Part Three

ONE OF THE TOP PERFORMERS AT THE INDY 500 HAS ONLY 21.7* HORSEPOWER.

Crown engineers, long known for their performance, have built a machine so powerful that just one has the capability of driving the entire 400 speakers at the Indianapolis Motor Speedway.

The **Macro-Tech® 10,000**, 16,200 watts* of burst power, is a masterpiece of audio technology: pure, natural, uncolored performance; incredible power; engineered to be as reliable as the Crown name itself.

An amplifier designed to deliver such power demands extraordinary circuitry throughout. Conventional circuit boards simply can't handle the necessary current, so Crown developed massive high-current copper conductors – 'BUSSBAR' construction.



Key to achieving reliability in amplifiers as powerful as the **Macro-Tech Series** and **Micro-Tech® Series** is successfully protecting circuits from overheating or overload.

Patented ODEP (Output Device Emulator Protection) circuits, utilizing onboard computers, simulate the condition of output transistors to detect and compensate for overheating and overload. Efficient heat sinking and forced-air cooling systems further ensure the reliability of these amplifiers.

Crown's patented Grounded Bridge Circuitry provides high output headroom – allowing extreme voltage swings without putting output transistors in series. The result is low distortion with extremely high dynamic range and greater reliability.

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fairly light, however, installers tend to make assumptions which frequently prove unsafe in the long term. While the structural failure of a small loudspeaker cabinet seldom presents a serious hazard, it can be avoided by anticipating conditions that could affect the choice of mounting techniques.

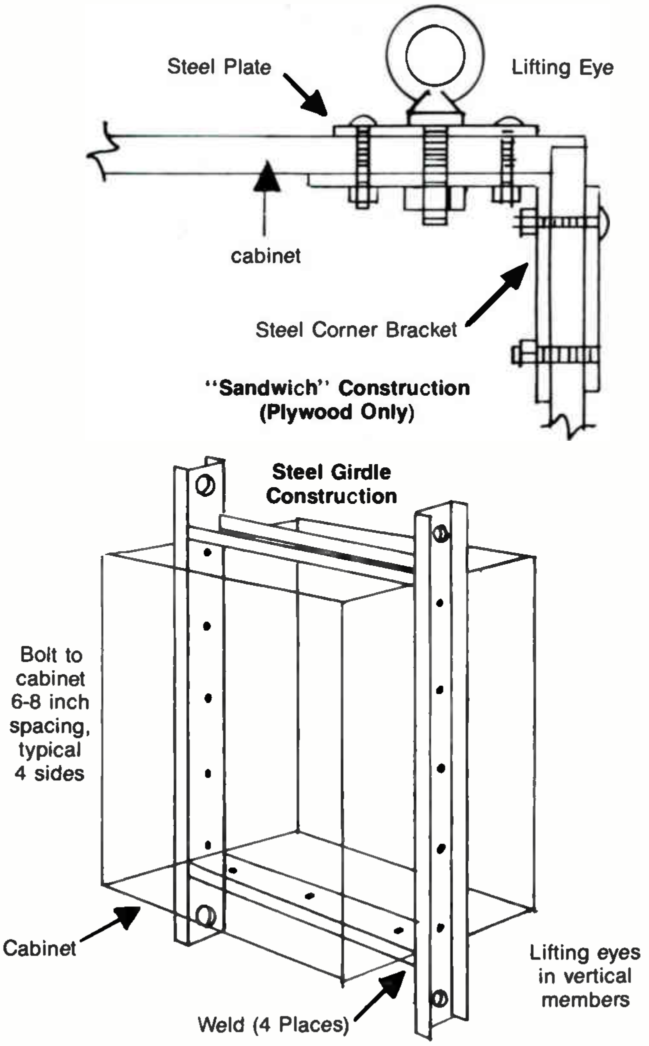

Figure 12. Cabinet Reinforcement

Caution: Small loudspeaker systems often employ snap-in grill assemblies, which usually attach to the cabinet with Velcro or similar re-usable fasteners. These mounting techniques, while satisfactory for home use, should not be relied upon for overhead installation in public places. Appropriate modifications are required.

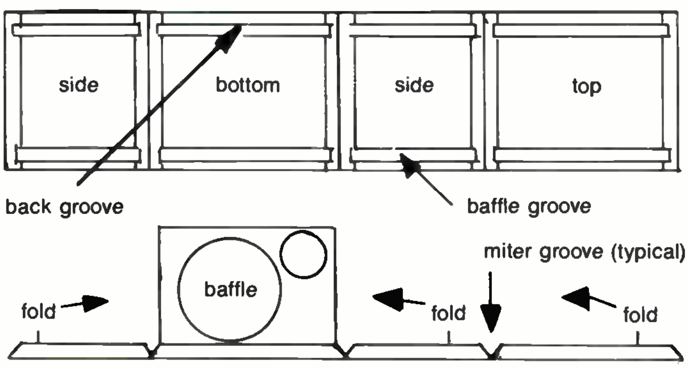

Figure 13. Miter-Fold Construction

Most small loudspeaker systems employ miter-folded particle board construction techniques (Figure 13). A plank of particle board is grooved longitudinally for inserting the baffle and back panel, milled transversely to the depth of the veneer to form the miter joints, then assembled by folding the sides around the back and baffle. Glue is applied at all panel intersections before folding, and the assembly is wrapped with elastic cord and set aside until dry. This type of construction depends upon the integrity of the glue bonds at panel intersections and the internal bonding strength of the particle board for structural integrity.

Figure 14 shows a variation of this construction technique. In this example, the top, bottom, baffle and back are miter-folded and the completed sub-assembly locks into dadoed grooves in the side panels. This method of joinery enables the attachment of hanging hardware to the top, bottom or back (depending upon total system weight), but the system should not be suspended from the sides.

Many other variations in construction and joinery are possible. It is the responsibility of the installer to examine the system and construction methods used to determine a safe attachment scheme for hanging hardware. (In small JBL systems that incorporate hanging hardware or attachments for hanging hardware, the locations provided have been chosen on the basis of strength of construction and the joinery methods used in the enclosure. *No other method of suspension attachment is recommended for these systems.*)

When particle board cabinets are to be suspended from T-nuts and eye bolts, installers should be aware of loading limits that attend this practice. New particle board will exhibit an internal bond strength of 60-70 psi (ASTM D-1037). A 1/4-20 T-nut in 3/4 inch material will subtend approximately 1.4 square inches of bonded surface, resulting in a nominal (breaking) strength of 85-98 pounds. Using an assumed design factor of 5, the maximum axial load on a single T-nut would become 17-20 pounds. Reduce these factors by one-third for half-inch material. This is for particle board that is new or in new condition only. Clearly, this is *not* an acceptable suspension method for large loudspeaker systems.

Conventional particle board is limited in application to interior use only—typical temperature and humidity conditions as encountered in a domestic residence or office environment. The resins used in the manufacture of most particle boards will not withstand prolonged exposure to moisture or high humidity. Wide variations of temperature will yield conditions of moisture saturation followed by evaporation, under which essential bonding agents will be leeched from the material. This process can eventually result in a cabinet with little strength.

The Installation Environment:

We have examined hardware systems and precautionary measures to ensure that the connections to the loudspeakers are made in a safe and secure manner. What remains is to properly hang the system in the installation environment.

For new construction, the sound system contractor should inform the architect of the planned hang points and the total weight to be concentrated on each point. The architect will then be able to provide the necessary load capacities and attachment fixtures as a part of the structural plans and specifications. *This information should*

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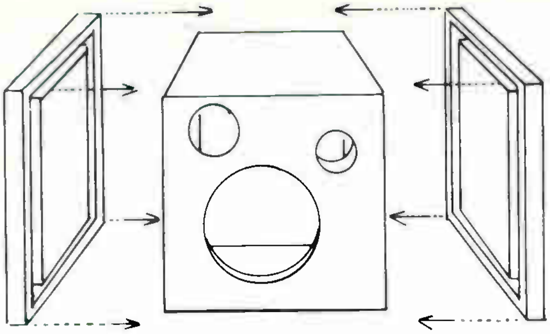

Figure 14. Alternate Miter-Fold Construction

be supplied for each and every suspended component, regardless of size and weight.

The task becomes more difficult in existing buildings and structures when adding sound facilities or remodeling existing systems. Most projects are undertaken without the professional services of an architect or structural engineer. Under these circumstances, the sound system contractor is left to his own devices to render a safe installation.

It is virtually impossible to predict the local conditions that a sound contractor may encounter in an installation environment. However, the following guidelines apply equally to any installation circumstance:

Glossary of Rigging Terms

BACK-STAY—Guy used to support a boom or mast. Also, that section of a main cable, as on a suspension bridge, etc., leading from the tower to the anchorage.
BASKET HITCH—A U-shaped two-leg hitch formed from a single sling.
BENDING STRESS—Stress imposed on the wires of a strand or rope by a bending or curving action.
BIGHT—The bend of a line, rope or cable.
BREAKING STRENGTH—The ultimate load at which a tensile failure occurs in the device being tested. This is synonymous with actual strength.
CABLE—A term loosely applied to wire rope, wire strand and electrical conductors.
CENTER OF GRAVITY—The point through which a load will hang from any attachment point.
CHOKER—A short sling that forms a slip noose around an object that is to be moved or lifted.
CLEVIS—See SHACKLE
COME ALONG—Device for temporarily holding or pulling loads on rope, chain or wire rope.
DEFLECTION—a) The sag of a rope in a span, usually measured at center span. b) Any deviation from a straight line.
DESIGN FACTOR—The ratio of the nominal strength to the total working load.
EFFICIENCY—Ratio of the nominal strength of a modified rope or wire rope to the nominal strength of an unmodified rope or wire rope—usually expressed as a percentage.
EYE BOLT—A machine bolt incorporating a circular fitting at the end for attachment purposes.
EYE, OR EYE SPLICE—A loop, with or without a thimble, formed at the end of a wire rope.
FC—(Fiber Core) Cord or rope of synthetic or vegetable fiber used as the axial member of a wire rope.
FITTING—Any functional accessory attached to a cable, rope or sling.
FLAG—Marker placed on a rope so as to locate the load position.
GUY LINE—A strand or rope used for stabilizing or maintaining a structure or lifting load in a fixed or predetermined position.
HITCH—A rope knot that unties readily that is used for temporary fastening.
IWRC—(Independent Wire Rope Core) A wire rope used as the axial core of a larger wire rope.
KINK—A deformation of a wire rope caused by a loop being pulled tight. It constitutes irreparable damage to and an indeterminate loss of strength in the rope.
KNOT EFFICIENCY—Ratio of nominal strength of a knotted rope to the nominal strength of a unmodified rope—usually expressed as a percentage.
LOAD ANGLE—Angle between the load (horizontal surface) and the sling.
LOAD ANGLE EFFICIENCY—The sine of the load angle defines Load Angle Efficiency, e.g., a 30 degree sling angle will have a load angle efficiency of 50%. The tension on each leg of the sling increases according to the reciprocal of the sine of the load angle.
MOUSING—Wiring the throat of a hook to prevent a choker from jumping out of the hook.
RATED CAPACITY—The load which a new rope, new wire rope, sling or fitting may handle under given operating conditions and at an assumed DESIGN FACTOR.
SAFETY FACTOR—See DESIGN FACTOR
SAFE WORK LOAD—Refers to that portion of the nominal strength of ropes, slings, chains and fittings that can be applied either to move or sustain a load. The term can be misleading, however, as it is valid only for new wire ropes and equipment in "as-new" condition. See RATED CAPACITY.
SHACKLE—A U- or anchor-shaped fitting with a pin.
SHOCK LOADING—A sudden movement or jerking of a load, such that the forces upon the hardware system are magnified over those imposed by the static load.
SLING—An assembly that connects the load to the lifting device.
SOFTENERS—Anything that is used to protect the load or cable, also rope and slings, from damage while making a lift, or hanging from a beam. Also used to prevent a load from slipping.
SPANSET—Trade name for polyester slings widely used in sound and lighting rigging work.
STRESS—The force or resistance within any solid body against alteration of form; in the case of solid wire it would be the load on the rope divided by the cross-section area of the wire.
SWAGED FITTING—Fitting into which wire rope can be inserted and then permanently attached by cold pressing (swaging) the shank that encloses the rope.
THIMBLE—Grooved metal fitting to protect the eye, or fastening loop of a wire rope.
WEDGE SOCKET—Wire rope fitting wherein the rope end is secured by a wedge.
WSC—(Wire Strand Core) A wire strand used as the axial member of a wire rope.

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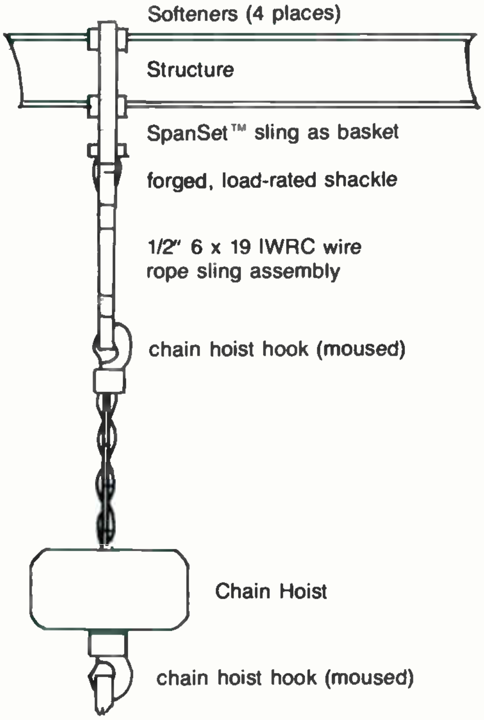


Figure 15A. Typical Rigging Chain (Upper Half)

1. **Never** attach or suspend loads to/from a wall or ceiling surface. Always make a secure attachment to structural members.
2. **Be absolutely certain** of the structural integrity of any member that is to be used to support external loads—hidden structures can have hidden weaknesses.

3. **Do Not** rely upon nails or wooden threads to support overhead loads—nails, wood screws, lag screws and lag screw eyes are untrustworthy.
4. **Never** assume anything. Owner or third-party supplied suspension points may be inadequate for the intended use.
5. **Recognize your limitations**. Seek help from competent outside sources—architects, structural engineers or rigging specialists—when uncertain or in doubt.
6. **Safety first**. Public safety demands that those responsible for placing equipment in potentially hazardous locations do so with full knowledge and use of appropriate precautions and safety measures.

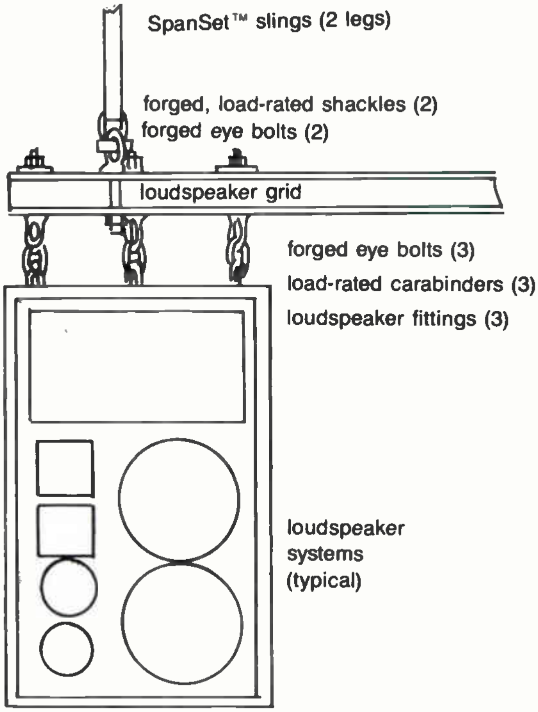


Figure 15B. Typical Rigging Chain (Lower Half)

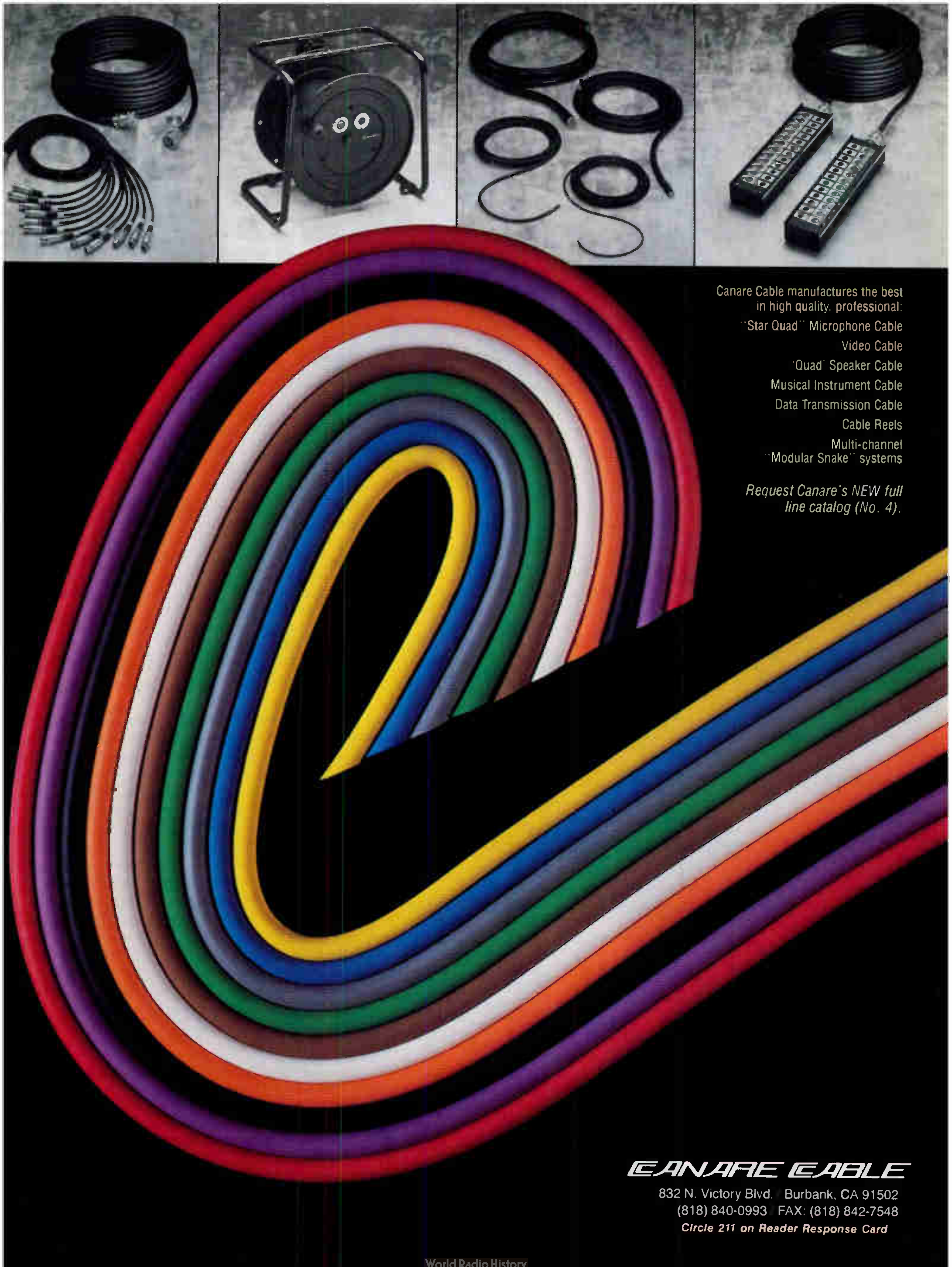
Hanging A System:

The first step in hanging a sound system is to obtain qualified advice about the load carrying capacity of the building or structure. The engineer or rigger will need to know how much weight needs to hang where. If the load isn't too heavy and you're not fussy, you may be fortunate enough to be able to hang in straight drops. Figure 15 shows a portion of a such a hanging system. Although the example shown is a portable sound system, the principals involved are identical for fixed installations with the substitution of a one-leg sling for the chain hoist. We will examine the rigging hardware system, beginning at the top.

The I-beam is shown wrapped with a SpanSet used as a basket sling. The corners of the beam are padded with softeners (burlap) to ease the tension of the outside fibers of the sling. We have chosen a sling that is of sufficient length to yield a 68 degree sling load angle, which gives us a load angle efficiency of better than 90%. Since our sling has a rated capacity of 7900 pounds at an assumed 5:1 design factor, the sling will have a rated capacity of 7900 pounds x 2 (basket sling) x 90% (the load angle efficiency), or 14,200 pounds.

An alternative sling is wire rope. Wire rope is preferred

(continued on page 68)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OF CHURCH

Common Errors Found in Church Installations and How to Avoid Them

BY CHARLES C. BAXLEY

A TUTORIAL

The purpose of this article is to describe some common errors Carey Associates has found in church sound reinforcement systems when we are called in to determine why a given installation is not performing up to expectation. Also included are some of our design criteria, which can be divided into two categories—those that you do, and those that you don't.

Most are minor items of concern to be addressed so that the system's overall performance will be improved, and small problems and irritants can be alleviated. Other items could be described as "crash-landings." If these areas are not handled properly, the system will never perform as successfully or effectively as expected.

Many of you may to feel that these points are pretty obvious and you would be absolutely correct. But these problems are not being addressed in the majority of churches that we have looked over the past two years.

We will further preface specifics by agreeing that the importance of different points can be argued. We are basing our observations on experiences in the field and the successes we have had when applying these principles. In addition, these techniques assume the use of constant directivity or pattern control horns, dependent on the terminology preferred. Some suggestions can only be implemented in new construction or major renovations, while others may be applied to rehabs.

The primary test tool we used to confirm most of the suspected problems on the sites in the Techron TEF® system, which is used to compare the before and after performance, to measure the improvements in intelligibility, and is also used in the mechanical and electronic convergence procedure.

Charles C. Baxley until recently was with Carey, Baxley and Associates, a design/consulting firm specializing in large-room electro-acoustics, with emphasis on the modern contemporary Christian church. They are located in Nashville, Tennessee. Baxley is now with Capitol Systems Design Group, a design/consulting firm in Jacksonville, Florida.

Don'ts

SOUND REINFORCEMENT

The true cause of lack of intelligibility in the room is not found because the coverge is measured after installation with an SPL meter or real-time-analyzer, both of which operate in the frequency and energy domains only. In a room with any kind of reverberant field, it is possible to obtain a nice plus or minus 3 dB throughout with these types of measurements by aiming a horn at the ceiling. The obvious result for any real-world application would be unusable.

The Most Common Error

The first item is the most common error we find. Unfortunately, failure to handle this properly is a crash landing.

Do cover the seats. The intent here is not to cause the church to put cushions in all the pews, but to have the sound reinforcement system supply audio to all the people in the seats. This does seem a little basic, and everyone tries to do this. However, it's not happening in application.

From our own mistakes, we suspect some reasons for this. The mapping technique used may not be a true three dimensional representation. While it's obvious the room is three dimensional, and equally apparent the sound wavefront is, too, it may not be as obvious that some two dimensional plotting technique can have errors gross enough to defeat the intent of the designer. Careful computations and adjustments must be made.

The Design

The design may not adequately consider the effects of operating horns being too close angularly to surfaces such as the ceiling. This problem occurs most often in balcony coverages. When there are sight lines to the main cluster, the first impulse is to simply aim a high Q device at the balcony. Problems arise if the horn cannot be aimed down far enough to keep the energy from the top half of the horn pattern at least at the 6 dB-down contour off the ceiling or other reflective surfaces. The cancellations and scatter effects will seriously interfere with the intelligibility and level in the balcony, and other seating areas may be adversely affected as well.

One solution calls for the installation of satellite clusters placed further back in the room in conjunction with signal delays. This gives better angles to the balcony, plus a shorter D2 (speaker-to-listener distance, see Figure 1). A second option consists of lowering the cluster position, if the other criteria permit. Another possibility would be to raise the ceiling. If there are sufficient other considerations supporting this move in addition to the balcony sound system requirements, raising the ceiling might not be as absurd as first thought.

A third attempt calls for stretching the coverage of a given device or using devices of inadequate Q so that fewer horns and drivers are called for. Both steps may be taken in order to save on budget.

There are sure to be other reasons for poor coverage design, but the idea here is to suggest that some extra thought be given to an area that in our experience is not getting the attention it deserves.

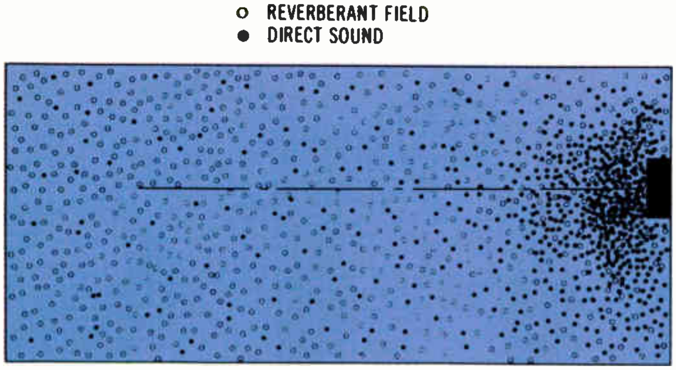
Do place the sound booth in the open. The booth should be placed in a position that is representative of a majority of the seats. A fine sound reinforcement system correctly installed will not perform to its potential when the operator does not hear the same tonal balance, timbre, and loudness as everyone in the room.

The back corner under the balcony does not qualify, neither does the top of the balcony on the back row up against the ceiling. Even worse is a closed room anywhere. We feel that the impact on the final success of the system is such that we will withdraw from a project if a suitable location cannot be worked out.

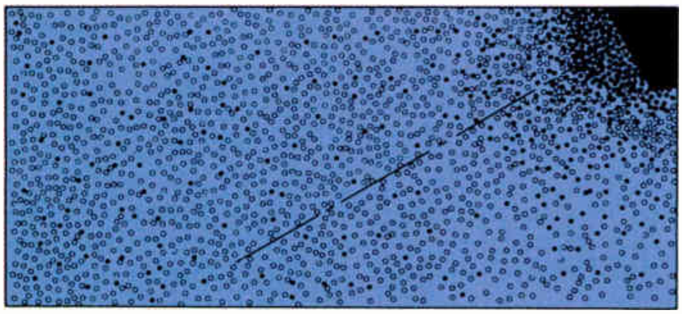
The Perceived Success

Although not a crash-landing, this next point can directly affect the perceived success of the installed system.

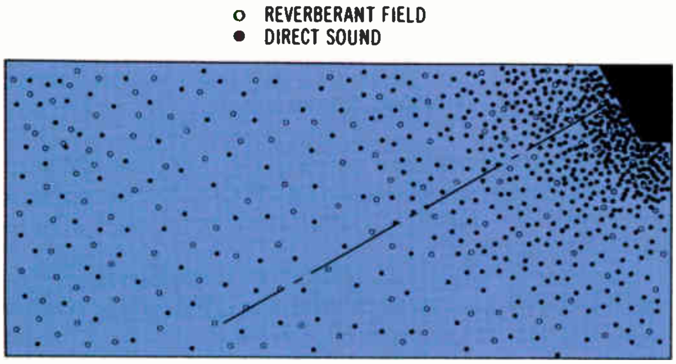
Don't give foldback to the choir. Don't try to let the choir hear themselves. If the attempt is made to provide enough



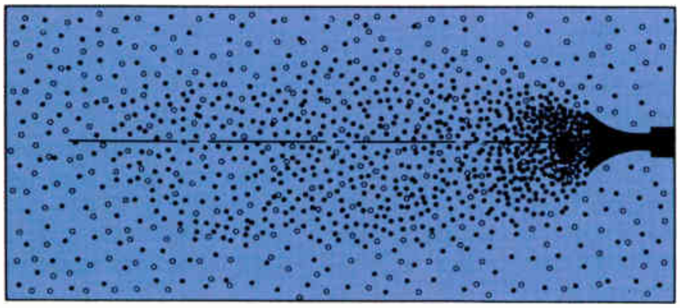
(A) Nondirectional loudspeaker.



(B) Loudspeaker in "live" room.



(C) Loudspeaker in "dead" room.



(D) Directional loudspeaker.

Diagrams courtesy JBL Inc./UREI, from Handbook For Sound Engineers, The New Audio Cyclopedia, Glen Ballou, Ed., Howard W. Sams & Co., 1987, p. 1007.

level to be heard over a choir member's own singing and those around them, the gain structure will be ineffective. Sufficient level to the house cannot be obtained before feedback, and most will feel the sound system is at fault.

However, you can provide monitors so that the choir can hear the service and the pastor. It is also generally acceptable to provide the choir director with some sort of personal monitor, such as small stand mounted variety.

Don't mic the choir more than necessary. Here again is an axiom we all know: use the minimum number of microphones with which you can get by. Still, time after time choir lofts that can be picked up by three or four microphones will have six or eight or even more. And the complaint? Can't get the choir loud enough before feedback.

Do use reflective/diffuse surfaces around the choir, which helps the sense of ensemble and assists the projection into the room. This sense of ensemble causes the members to sing out more, and thus further enhances the projection of the choir. This means less acoustic gain (NAG) from the sound source will be needed, and the system will be loud enough without going into feedback.

Don't bolt the microphone to the pulpit. Practically every pulpit picks up the sound system and resonates. Without a very good isolator, this couples to the mic and causes speech to sound hollow and muddy, with the associated loss of intelligibility. It also adversely affects the gain before feedback. In particularly bad situations, the only solution is to mount the microphone on a separate stand and boom.

Small Considerations

The last items are small considerations that make the whole system easier to operate and to live with. These increase the perceived value and success of the sound package to the client.

Do place mic receptacles as needed. On the larger platforms that are becoming more prevalent, receptacles should be spaced about 15 feet apart. This allows full usage of the platform space without masses of cables running everywhere.

Do use floor pockets. As church music programs continue to grow, access to multiple mic inputs, monitor feeds, and communications at various locations dictate the installation of theatre-type floor pockets as opposed to individual floor boxes.

Don't skimp on floor pocket interconnects. If you have two or four channels of production communications, make sure they all appear in all floor pockets. The same thing applies to monitor send channels. However many are available, put them in all the pockets. This philosophy should be carried throughout to any com or monitor outlet location in the building. We have found this really makes the operators happy; nobody has to remember which channel of what is available where.

A future article will deal with the convergence of multiple-horn clusters, which involves mechanically and/or electronically bringing the separate devices into coherency so that they work together to approximate a single point source with minimum of interference and comb-filtering. With today's technology there is no excuse not to do so. We believe that failure to converge a system seriously degrades performance. ■

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University at Buffalo's Alumni Arena

By Greg Nolte, Design Engineer
Comcast Sound Communications, Inc.
Buffalo, New York

Alumni Arena, a five-story fieldhouse, is named for the more than 100,000 students who have graduated from the State University of New York at Buffalo since it was founded in 1846. Designed basically as an athletic facility, Alumni Arena is the only facility on the University's campus capable of seating in excess of 9,000 people. It is used for numerous large events.

The arena's physical structure is 288 feet long, 264 feet wide, and 62 feet high to the lower chord ceiling support and 80 feet high to the upper chord ceiling support—for a total volume of almost five million cubic feet. The roof of the building is supported by a space frame consisting of steel girders (chords) in 24 foot squares, each 18 feet high. The facility's interior wall surface is unpainted bare concrete block.

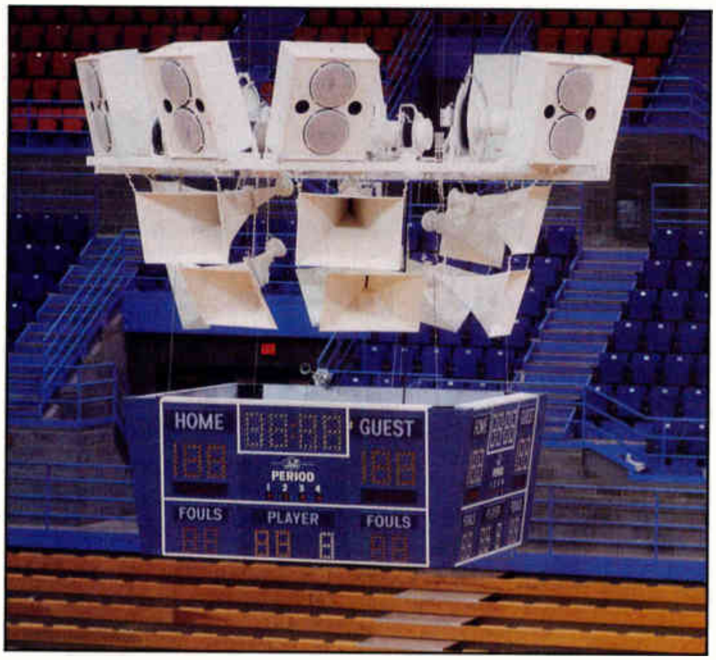
The 48,000 square foot arena floor provides space for a competition basketball court (plus two additional basketball courts), a competition volleyball court (plus three additional volleyball courts), and eight badminton courts, all of which are encircled by an eight-lane, 200-meter running track considered to be one of the finest indoor ovals in the eastern United States. Two divider curtains suspended from the roof beams can be used to partition the floor into three distinct areas. A four sided center court scoreboard is suspended above the playing field.

The hardwood maple playing surface is the largest "free-floating" wooden floor in the world; it compensates for change in temperature and humidity by continuously expanding and contracting as needed. The floor is made of 114 tons of plywood covered with 116 tons of hardwood maple and cost about $260,000.

Twenty-four huge air ducts continuously circulate clean, fresh air to keep the atmosphere from becoming stale. The superstructure roof support is the latest in a two-way pyramidal truss design, well supported by 800 tons of steel.

THE DESIGN

Larry King, acoustical consultant with Klepper Marshall King Associates, Ltd., White Plains, NY, was engaged to design the sound system for SUNY's Alumni Arena. The facility, constructed of sound-reflecting concrete walls and sound-absorbing roof deck, is a highly reverberant space. The measured background noise level is approximately NC-45 with all house lights on and the air conditioning running. The estimated reverberation time for the occupied arena is 2.5 seconds, while the measured unoccupied reverberation time is 4.5 seconds. During the initial design phase, KMK established specific functional and performance requirements for the sound system, and reviewed these with the client. These requirements were the basis for the final design.



Central Cluster D

KMK was responsible for electrical and rigging design. Gordon L. Crone, PE, East Aurora, NY, provided electrical consulting services, with J.R. Clancy, Syracuse, NY, as rigging contractor.

THE INSTALLATION

Comcast Sound Communications, Inc., an Altec Lansing sound contractor in Buffalo, N.Y., was awarded the project for the arena's total sound system.

The two-way pyramidal truss roof limited the amount of weight it could support, and special considerations had to be given during the rigging and acoustical design.

THE SOUND SYSTEM

The sound system is made up of two main loudspeaker clusters ("E" and "D"), and three satellite clusters (C, B_1, and B_2). The clusters are labeled for identification on the block diagram. Cluster E consists of Altec Lansing 817As with 515-8GHP loudspeakers, four MR42A Mantaray® horns, two MR94As, and two MR64As each with Altec Lansing 906-8A compression drivers. Cluster E is suspended above the south end of the arena floor and covers the main floor and the north, east and west fold-out bleachers (about 3,000 seats). Cluster E's principal function is for use during ceremonies where chairs are placed on the main floor (commencements, concerts, etc.). It was designed to meet very high quality music and speech reproduction requirements.

The three satellite clusters (B_1, B_2, and C) are strategically placed to cover the fixed seating areas. Clusters B_1 and B_2 each consist of the following Altec Lansing components: MR94A Mantaray horns with 906-BA compression drivers and 8256 bass cabinets loaded with 3156s. The third satellite cluster (Cluster C) is made up of: Five MR64A Mantaray horns with 906-BA compression drivers and two 8256 bass cabinets loaded with 3156s.

A second, central cluster (Cluster D) is made up of: MR64As and MR94As on the north side; MR64As on the east and west sides, and MR42As and MR94As on the south side. Each Mantaray horn uses a 906-9A compression driver. Also included in Cluster D are eight 8256 dual bass cabinets with 3156s—two per side to cover each major seating area. Cluster D is suspended over the center of the floor above the scoreboard. It is used for sporting events such as basketball, volleyball, and track. The satellite clusters are also employed with the D Cluster, but with the appropriate signal delay changes to cover the upper balcony seats.

The E & D clusters are suspended by motorized rigging systems, and C, B_1 and B_2 satellites are suspended by hand-crank winches. Designed by J.R. Clancy, the winch systems allow the University staff to evaluate and repair the drivers at floor level.

Alumni Arena Equipment Racks

LOGIC PANEL

Because the arena is a multi-purpose facility, sections of the sound system can be activated and deactivated using a custom designed logic panel. This allows the coverage patterns to adjust for different functions held in specific segments of the arena. The configuration (LOGIC) select was designed around an FSR, TA-8 using Potter Brumfield relays for logic switching and FSR-LK4 relays for audio line level switching.

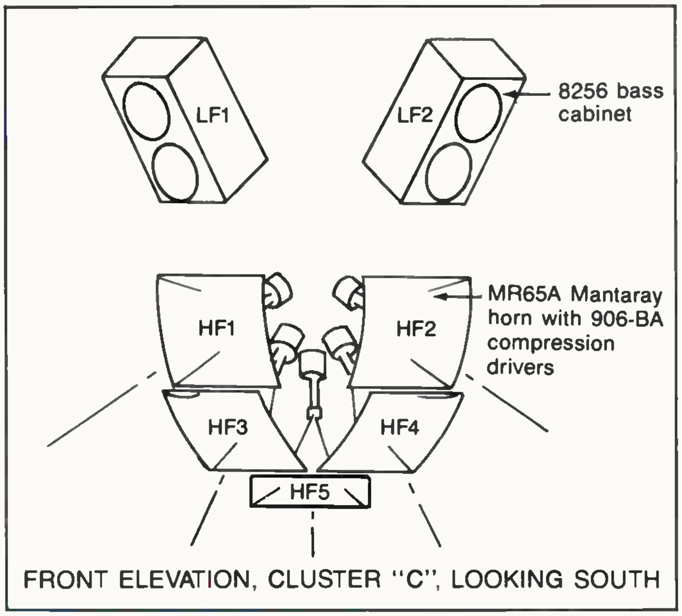
FIRE MARSHALL PANEL

A break-glass microphone panel was installed in the arena. It was designed to switch on the system or override any present programs. The logic activates the D Cluster and the satellites. An Altec Lansing 1612 limiter amplifier is used to directly input the system and control the level of the Fire Marshall microphone. The second input is reserved for a future audio evacuation system.

AC SYSTEM POWER CONSIDERATIONS

The 120 VAC incorporates a General Electric RMS-5BL dual motor sequential switcher to activate all processing equipment and then each individual amplifier. Deactivation is accomplished in just the opposite manner.

A portable processing rack contains the Tandberg 910

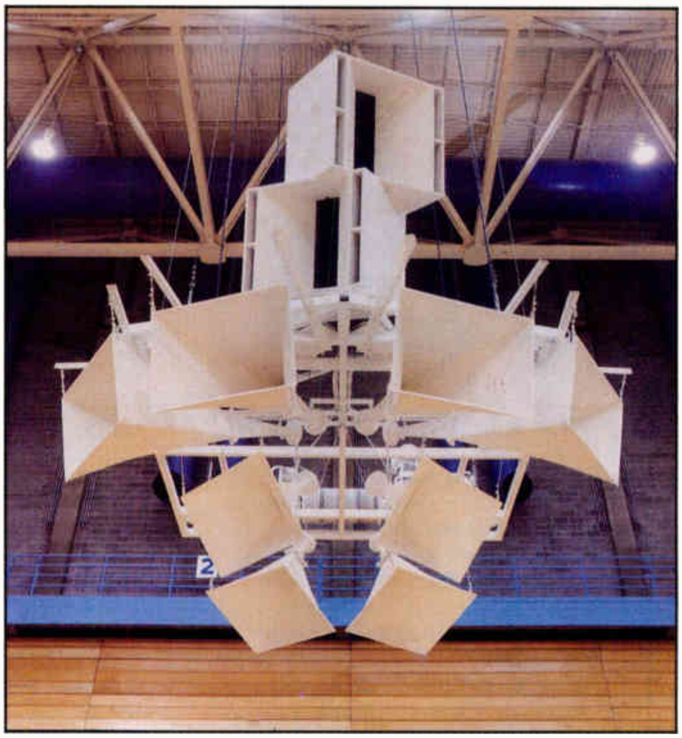


Model drawing of third Satellite Cluster C

cassette recorder along with a Klark Teknik equalizer, UREI notch filter and compressor limiter allowing the system to be tuned for maximum gain at the desired microphone locations. Another portable rack contains a Klark Teknik equalizer and two Altec Lansing 1269 amplifiers for spot fill and another Klark Teknik equalizer with a 1269 amplifier for foldback.

The main floor loudspeaker cluster (E), the offset satellites (B_1 and B_2), the main satellite (C) and each individual direction of the central cluster (D) are individually equalized.

Because of the number of system equalizers and the interaction of the cluster sections, the overall tuning took two



Central Satellite Cluster C

engineers three days to accomplish and document. Bill Kolts from the Indianapolis office and this author credit Larry King of KMK not only for the overall design but for the intricate mounting angles of the loudspeaker components. These dimensions were followed precisely by the installation crew, with Jim Crone and Rick Thompson in charge.

The University operators, trained by Mark Greenfield (Coordinator of Lecture Hall Services), have the task of setting up the portable aspects of the system, feedback notching, setting of compression levels appropriate for the event, etc.

"During the year that we have had the use of the system [prior to this rented systems were "flown" from the roof trusses], we have had extreme flexibility with the system," says Kevin Lijewski of SUNY. He also states that "from routine basketball games, throughout the New York State Olympic games, and during federation wrestling matches, the multi-array approach has allowed us to appropriately configure the system." Because of the fold-out bleachers, which are not always used, it is possible to shut down coverage in those areas, thereby reducing the reverberant level, and maximizing speech intelligibility in such a large space.

KMK credits the SUNY Buffalo Engineering Services (Educational Communication Center) personnel (Kevin Lijewski and Ron R. Cichocki, specifically) for their extremely detailed and dogged supervision of the installation, including punch list preparation, and operational and equipment suggestions. This sound system installation represented a collaboration among professionals, each a specialist in his own field, but coordinated by Engineering Services.

Capable of 105 dB SPL peak levels, the sound system has no problem overriding the roar of an enthusiastic volleyball championship. After many sound system rentals, the personnel in the University's Engineering Services have come to know intimately just how well and how badly the arena had been covered in the past. Although rental systems were not "the answer," they presented good comparisons for a permanent system. "We believe we have the best possible system within the constraints of budget and space-frame weight limitations, to the credit of the designer, Larry King, and the sound contractor, Greg Nolte," says Lijewski.

"I am pleased with the performance of Altec Lansing products. The sound system sounds great!" says Larry King of KMK, supervising a "first birthday" checkout of the system in March, 1988. ■

PARTIAL EQUIPMENT LIST
ALUMNI ARENA

7	Klark Teknik DN360	Dual 1/3 Octave Equalizers
8	Altec Lansing 1631A	Electronic Crossovers
1	Altec Lansing 1612B	Limiter Amplifier
24	Altec Lansing 1269	Dual Channel Amplifiers
4	Altec Lansing 1698A	Amplified Monitor Panels
6	Altec Lansing MR42A	40 x 20 Mantaray® Horns
15	Altec Lansing MR64A	60 x 40 Mantaray® Horns
10	Altec Lansing MR94A	90 x 40 Mantaray® Horns
31	Altec Lansing 906-8A	Compression Drivers
13	Altec Lansing 8256	Dual Low Frequency Cabinets
2	Altec Lansing 817A	Dual Bass Horn Cabinets
4	Altec Lansing 515-8GHP	Loudspeakers
2	Altec Lansing 409T	8" Ceiling Loudspeakers
1	Tandberg 910	Cassette Deck
3	UREI LA-4	Compressor Limiters
1	UREI 562	Notch Filter
1	GE 5BL	Sequential Switcher
3	IRPI	Signal Delays
5	Soundolier 500-77	Equipment Racks
1	Yamaha M916	Mixer

THIRD ANNUAL SURVEY OF THE CONTRACTING BUSINESS

Where is the contracting market today? Where was it yesterday? And where will it be tomorrow? Once again, *Sound and Communications* sought out the answers to these questions by questioning the source — the sound contractors themselves.

This May issue marks the third annual publication of the results of our annual survey into the workings of the contracting industry.

In general, sound contracting is a stable industry. It is showing growth that is rational and controlled. But it's not without its complaints. We gave our survey respondents room for comments. And they commented. You'll read some of their comments in this report.

Our surveys were sent out to a random sampling of our sound contractor readers in March. We tabulated the results in April. We had a response rate of 27 percent.

And this is what we found:

Without a doubt, the vast majority of sound contractors do the vast majority of their business in sound reinforcement.

But many of them are diversified into many aspects of the sound and communications market, not depending on one facet for their livelihoods.

This is an industry of small businesses. Fifty-three point eight percent of our respondents have under 11 employees.

The average sale of an installed system for 1987 was $16,565.29.

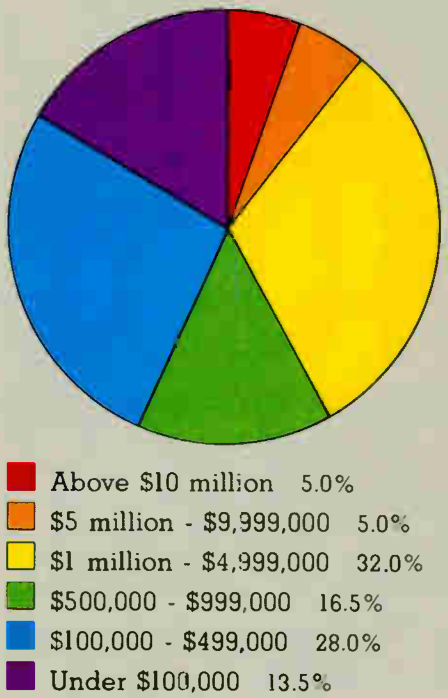
The product mix will be changing somewhat next year, with more people more concerned with the neglect of videoconferencing systems and security systems.

TOTAL DOLLAR SALES

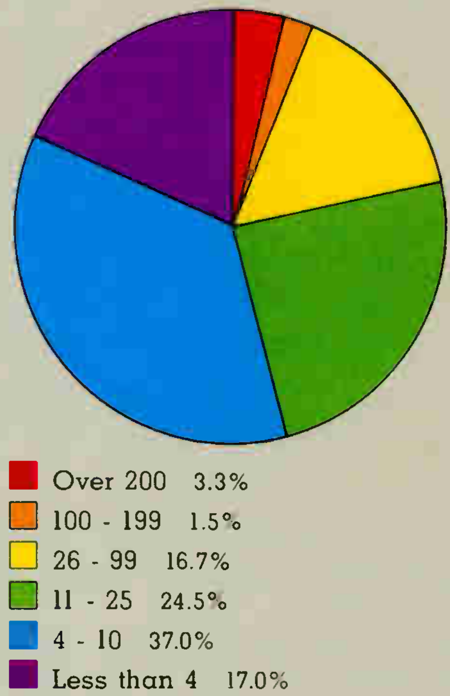
The contracting market is made up of small businesses. Fully 58 percent of the contractors have total dollar sales of under half a million dollars. However, 32.2 percent have sales of between one million and five million dollars. And a full 10 percent have sales above five million (with five percent above 10 million dollars).

These results are slightly different from last year's survey. Last year, 15 percent of the respondents reported sales under $100,000 (versus 13.5 percent this year.) Other figures showing downward trends were in the under-a-million-dollar category. These figures were picked up in the middle classification — $1,000,000 to $4,999,000. Last year 27 percent of the respondents had sales in this category. This year 32.2 percent responded here. The broad middle has therefore once again expanded (we saw the same sort of change indicated last year), the lower end has dropped in frequency, and the higher end has remained the same with ten percent of the respondents last year *and* this year reporting sales of $5,000,000 and over.

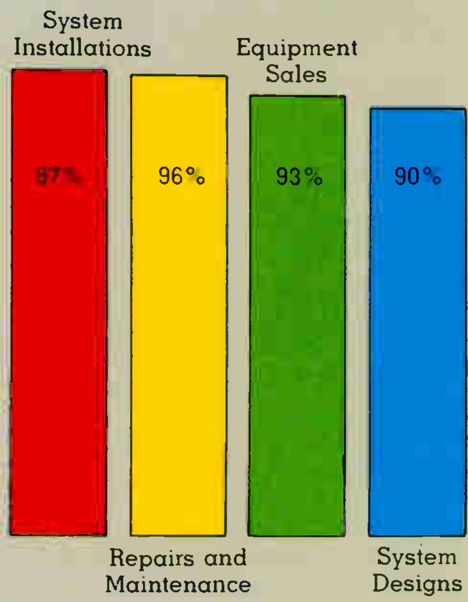
TOTAL DOLLAR SALES



NUMBER OF EMPLOYEES



SERVICES PROVIDED



SIZE AND SERVICE

How large are the individual sound contracting companies? The bulk of the respondents — 36.8 percent — have between four and 10 employees. But a full 17 percent have fewer than four employees. At the high end, 3.3 percent report having over 200 employees, but only 1.5 percent have between 100 and 199 employees. Seventy-eight point three percent have under 26 employees.

What sort of services do contractors provide? Almost all contractors (96.7 percent) do system installation, with slightly under that (96 percent) doing repair and maintenance. Not everyone considers himself as doing equipment sales (only 92.6 percent responded positively to that question). Eighty nine point three percent provide system design.

How big is the job? Our respondents reported an average dollar size of installed systems for 1987 at $16,565.29. That, keep in mind, is the average. However, the average of the largest size of installed system had a cost of $151,120. The typical time from order to finished system was 80 days. This works out to about 2.6 months, whereas last year the average job took about three and a half months.

What markets are served by the sound contractors? Our question divided the broad market into four sections: sound reinforcement, local wired intercom, background music, interconnect and 'other.' These categories were then broken down into subcategories, which totaled 25. Respondents were asked what their most important markets were in 1987, what the percentage of sales was in 1987; what their projected most important markets and percentage of sales were for 1988.

By far the largest response was in the Sound Reinforcement category, with 93 percent of the responses in that category. (Respondents were free to check as many markets as they wished.)

A comparison of figures for 1987 with projections for 1988 showed an interesting trend. Almost without exception markets checked as most important in 1987 were seen as less important in 1988. Yet, again almost without exception, projected percentage of sales was up from 1987 to 1988. Apparently, respondents are hoping to increase sales in the stated categories, while increasing their attention on other markets.

What are those other markets? Respondents answered the next question: Which three areas do you feel are the most neglected by sound contractors. Video systems garnered 18 percent of the vote; teleconferencing 15 percent; security and fire alarm 14 percent.

For the question "Which three areas would you like to expand in?", the answers were 24 percent in video systems; 15 percent in security and fire alarm; and 15 percent in nurse call.

Of the markets served by our respondents, 60.3 percent of the responses included local wired intercom, with 16 percent of the responses for nurse call, and nurse call accounting for 14.2 percent of those respondents' percentage of sales in 1987.

Thirty percent of our respondents considered background music one of their most important markets; and thirty-three percent checked off interconnect. While 15.7 percent sold background music system hardware and did installation, on-