THE B . A . S .
S P E A K E R

The Boston Audio Society
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August meeting. The next meeting of the B.A. S. will be held at 6:00 p.m. on Sunday August 19 in B. U.'s Myles Standish Hall at 30 Bay State Road, one block below Kenmore Square. Mark Davis, who is doing advanced study at MIT in acoustics and psychoacoustics, will set up an array of sophisticated test equipment including a real-time spectral analyzer fed by a calibrated microphone, a pink-noise generator, and a 1/3rd-octave audio filter set. With the aid of this laboratory Mark will discuss the importance of such parameters as frequency response and phase response, and will demonstrate such things as: the distribution of power versus frequency in various kinds of music; the response of speakers in a room environment; and the extent to which different-sounding speakers can be made to sound alike by equalizing their response through 1/3rd-octave filters. Come early and stay late.

Activities lists. Enclosed with this issue are the listings of members who have indicated positive interest in various group activities. The listings, together with the BAS phone directory distributed in July, will provide you with the means of identifying and getting together with other BAS members who share your special interest. We encourage you to take the initiative now to invite fellow members to an informal listening, discussion, evaluation, or planning session.

B.A.S. Publication. This month's featured BAS article is a foray into the thicket of speaker efficiency. Did you know that in the average stereo installation a sound pressure level of 90 dB will be produced with less than five watts per channel of amplifier power? The article is in part deliberately provocative, not to say pugnacious, with the expectation that we can at least provoke discussion of the subject even if we cannot induce the industry to really change its policy of silence on the relative efficiency of speakers.

Elections. The September meeting of the BAS will be the Annual General Meeting and will include the nomination and election of officers for the following year. Although nominations will be accepted from the floor in September, we would like to list proposed nominees in the September newsletter for members' consideration. So if you wish to nominate yourself or another for an office (and a job!), please let us know before the end of August.

Imported records. David Letterman reports that the records ordered from England have arrived and have been delivered to the members who ordered them. The Record Importing Committee will place its next order when enough records are ordered to qualify for free shipping. See Dave to place your order; he has catalogs of British and European records.

BAS Dubbing Service. Low-noise tape for use by the Dubbing Committee was purchased with the bulk tape purchase for members. Henceforth if you request a recorded tape through the Dubbing Committee the price, including the $2. 00 service fee, will be $5.80 for open-reel (Maxell UD-35) or $4.60 for cassette (Advent CrO_2 C-90). Non-musical tapes such as "Shop Talk" can be made on standard-oxide tape for about $1.00 less.

Burglary. The recent experience of two members prompts this reminder that burglary and theft remain serious menaces to our stereo installations. You may find one or all of the following suggestions useful. (1) Check your home insurance policy to be sure that your equipment, records, and tapes are fully covered. For apartment dwellers theft insurance costs about $50/year. (2) After a loss the insurance company may become reluctant to believe that you had as much valuable stuff as you claim. So make an inventory of your belongings. Take pictures of the inside of your home in sufficient detail to identify everything of value. Collect all of your sales slips. Tape record a spoken description of everything (make, model, serial number, cost), including the numbers of the more expensive tapes, records, and boxed sets in your collection. (You could write all this down but talking it into a mike is quicker and easier.) Then store the pictures, sales slips, and/or tape in a safe place outside of your home, in a safe deposit box or in a locked file drawer at your office. (3) Buy — $15 — or borrow from your friendly police department a carbide electric engraver, and engrave your name and address or driver's license number into the metal chassis of each piece of gear; then place stickers on doors and windows warning potential thieves that your valuables all have engraved identification. (4) When you are not at home set a 24-hr clock timer to switch on the FM receiver and a couple of lights in the evening, off at midnight. (5) As a last resort consider a burglar alarm, but note that low-cost alarms are easily defeated and a waste of money, usually.

Audio engineering. We have received a communication from Paul Moverman, 225 Merrymount Drive, Warwick, R.I. 02888. He is planning a book, "A Students' Guide to Audio Engineering," including surveys of studio recording activities, educational opportunities, publications and careers in the field, both in North America and Europe. He desires information and photographs on these subjects. If and when the book is published we would hope to review it.

Pre-recorded tapes. As the erratically poor quality of disc pressings becomes increasingly annoying, open-reel pre-recorded tapes become more attractive. In the past recorded tapes have tended to be too hissy, too high-priced, and too hard to get. This situation is improving. In addition to Ampex's recently-instituted mail-order system, we would like to call your attention to Barclay-Crocker, an attractive but little-known mail-order outfit which is placing major emphasis on supplying a large variety of open-reel tapes, including esoteric as well as popular repertoire. Three-fourths of their sales are classical, notably from DGG, London, and RCA, mostly at 71/2 ips, and quite a few of the tapes are Dolby-B (especially the Londons). Barclay-Crocker's price is usually about 23% below list. They have a large and very detailed catalog costing a dollar. The address is Barclay Crocker, 11 Stone St., NYC 10004.

Advent tour. About 8 BAS members were given a complete tour of the Advent factory in Cambridge on July 25. The tour included: the assembly lines for the Advent Dolby units and cassette machines (whose circuit boards contain an intricate forest of components); the surprisingly extensive facilities for testing and adjusting each unit before it is packed; the astonishing process whereby a liquid (paper pulp) is poured into a mold and emerges, after a brief vacuum-pressing, as a speaker cone; the systems on which Advent is producing recorded cassettes; and Advent's VideoBeam projection color TV, now in production, for which they make their own special lenses and screens as well as the circuits. Blanid Tardif suggests that the most impressive aspects of the tour were the TV with its incredible 24-square-foot image, the production design and attention to detail which permit Advent to employ many non-technically-educated minority-group personnel to produce sophisticated products, and Andrew Petite's gracious and informative services as a guide.

July meeting. About 40 members assembled on July 22 at the recording studio of Renaissance, Inc. Cases of Maxell UD-35 open-reel and Advent CrO_2 C-90 cassette tapes were delivered to the members who had ordered them at the June meeting.

Chuck Ange and his crew at Renaissance, aided by Rene Jeager and Al Foster, conducted a live-versus-recorded experiment. Unanticipated difficulties caused the session to start late and run long, but the result was so informative as to be worth the wait — especially for those members who were able to remain through the entire meeting. The session started with a fine performance of five Mahler songs by Nancy Grant (graduate student in voice at the New England Conservatory) and pianist Alan Grossman, professor at B.U. They were recorded and then played back through a McIntosh 3500 amp into Dayton-Wright Mk II full-range electrostatic speakers (for which Renaissance is the area dealer). The piano sound on playback was good but the vocal sound was heavy, lacking the light, lithe quality of Ms Grant's live voice. So a Mahler song was re-recorded using entirely different mikes and mike placement, resulting in less realistic piano sound but a distinctly better vocal recording. This tape was then used for multi-way A/B comparisons between pairs of Dayton-Wrights ($2000/pr), AR LSTs ($1200/pr), double pairs of Advents ($400), and repeat performances by the live musicians ($oo). The opinion of members was split on whether the live sound was more closely matched by the LSTs or by a single pair of Advents (the double pair having suffered from mutual coupling where they were placed).

For another test, baritone Dennis Boyer (WBUR producer and graduate student in voice at B.U.) and pianist Gerhard Suhrstadt gave a delightfully rousing performance of a Schubert song. On playback the Mc3500 went into distortion trying to drive the Dayton-Wrights to the same loudness as the live voice in the huge studio. (In a normal living room the Dayton-Wrights would go about 10 dB louder before amplifier clipping set in.) The LSTs and Advents, driven by a Phase Linear 700, were loud enough, and majority opinion favored the LST as more closely simulating the live voice.

For the last and most educational experiment of the day, Chuck Ange arranged six different mikes to record simultaneously on a multi-track recorder, as Jim Bryan performed varied compositions on classical guitar. On playback the differences among the six recordings (due to various mike characteristics and placement) were shockingly great — much greater than the differences in tonal character among the speakers, even though the mikes were all high-grade professional ones. Thus it was suggested that except for the audibly superior transparency of the full-range electrostatics, the conclusions drawn about the relative merits of loudspeakers were suspect because of the large effects which mike choice and placement can have on the recorded sound.

Two other conclusions were apparent. At no point was the record/playback sound realistic enough to confuse with the live sound. And many members found so much pleasure in the musical performances of Nancy Grant, Alan Grossman, Dennis Boyer, Gerhard Suhrstadt, and Jim Bryan, that they regretted stopping for the A/B comparisons.

Finally, the BAS owes special thanks to Chuck Ange and Rene Jeager for the personal effort and expense which they invested in hosting this BAS meeting.

Used Equipment for Sale. Heath IM-17 portable FET-VOM. Measures DC voltages from 0.05 - 1000 V, AC voltages from 0.2 - 1000 V, resistances from 0.2 ohm to 100 Meg. AC frequency response 10 Hz to 1 MHz. Input impedance 11 Meg DC, 1 Meg AC. Assembled, tested, and calibrated, $30. Peter Mitchell.

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B.A S. ACTIVITY/INTEREST LISTINGS

OPERA
Dennis Boyer
Al Foster
Harry Zwicker
Al Southwick
Frank Domohoski
Victor Anderson
Blanid Tardif
David Letterman

SYMPHONIC MUSIC
David Letterman
Rudy Boentgen
Al Foster
George Kaplan
Carl Covell
Joel Cohen
A1 Southwick
Dennis Boyer
Peter Mitchell
Jim Richardson
Frank Domoho ski
Rene Jeager
Victor Anderson
Harry Kane
Blanid Tardif

CHAMBER MUSIC
Laurie Cote
Carl Covell
Joel Cohen
Harry Zwicker
David Letterman
Dennis Boyer
Jim Richardson
Al Foster
Victor Anderson
Al Southwick
Blanid Tardif
Frank Domohoski
Peter Mitchell

MODERN MUSIC
David Letterman
Rudy Boentgen
Carl Covell
Harry Zwicker
Al Southwick
Rene Jeager
Victor Anderson
Blanid Tardif

ELECTRONIC MUSIC
Harry Zwicker
Al Southwick
David Letterman
Blanid Tardif

FOLK MUSIC
Al Southwick
Victor Anderson

JAZZ
Al Foster
Harry Kane
Rene Jeager
Al Southwick
David Letterman

ROCK
Al Foster
Frank Domoho ski
George Kaplan
Al Southwick

KITS
J. K. Pollard
Bob Cleary
Al Southwick
Dennis Boyer.
Jim Richardson
Harry Kane
Carl Covell
Al Foster
Laurie Cote
Peter Mitchell
Frank Domohoski

78-rpm RECORDS
David Letterman
A1 Southwick

TAPE DUBBING
Al Southwick
Rudy Boentgen
Laurie Cote
Jim Richardson
David Letterman
Frank Domohoski
Victor Anderson
Peter Mitchell

LIVE RECORDING
Rudy Boentgen
Al Southwick
Al Foster
Laurie Cote
Dennis Boyer
Rene Jeager
George Kaplan
Michael Swain
Victor Anderson
Peter Mitchell
Frank Domohoski

EQ. TEST CLINICS
Rudy Boentgen
Al Foster
George Kaplan
Carl Covell
Laurie Cote
Joel Cohen
Al Southwick
J.K. Pollard
Dennis Boyer
Michael Swain
Bob Cleary
Jack Stevens
Frank Domohoski
Harry Kane
Peter Mitchell

EVAL. CARTRIDGES
Frank Domoho ski
Al Foster
George Kaplan
Carl Covell
David Letterman
Joel Cohen
A1 Southvii.ck
Dennis Boyer
Jim Richardson
Harry Kane

EVAL. TUNERS
Al Foster
George Kaplan
Carl Covell
Joel Cohen
Al Southwick
J.K. Pollard
Dennis Boyer
Michael Swain
Laurie Cote
David Letterman

EVAL. RECORDERS
Al Foster
J. K. Pollard
Dennis Boyer
George Kaplan
Joel Cohen
Al Southwick
Michael Swain
Laurie Cote
David Letterman
Peter Mitchell

EVAL. AMPLIFIERS
Rene Jeager
J. K. Pollard
Al Foster
George Kaplan
Al Southwick
Carl Covell
Dennis Boyer
Joel Cohen
David Letterman
Michael Swain
Peter Mitchell

EVAL. SPEAKERS
Laurie Cote
Wendell big
David Letterman
Harry Kane
Rene Jeager
Frank Domohoski
Jim Richardson
Michael Swain
Dennis Boyer
Peter Mitchell
Al Southwick
Harry Zwicker
Joel Cohen
Al Foster
Carl Covell
George Kaplan

EVAL. ACCESSORIES
Al Foster
George Kaplan
Jim Richardson
Peter Mitchell
AI Southwick
David Letterman
Frank Domoho ski
Dennis Boyer
Michael Swain

A Publication of the B.A.S.

SPEAKER EFFICIENCY : AN INITIAL REVIEW

by Peter W. Mitchell

For many people buying stereo equipment, the question of whether to spend an additional $50 - $100 to get a 60-watt rather than 30-watt amplifier is an important one. Yet few people consider the fact that the choice of loudspeaker can completely offset that doubling of amplifier power. How many audiophiles are aware, for example, that KLH-17s driven by a 20-watt amplifier can play louder than Small Advents driven by a 60-watt amp ? If, like many listeners, you never play music louder than a 90-db sound pressure level, then this difference is irrelevant; any speaker on the market can be driven comfortably to 90 db in a living room by a good 20-watt-per-channel amplifier. So you can select loudspeakers on the basis of their sound character, bass range, size, appearance, and cost. But if you want to reproduce the 100-db levels of a full orchestra in a concert hall or a grand piano in a salon, you ought to consider the speaker's efficiency as well as its other parameters, or else be prepared to buy a big amp.

Probably the reason why people don't consider loudspeaker efficiency carefully is that manufacturers have made useful data on relative efficiency hard to obtain. The Standards Committee of the Institute of High Fidelity, which is responsible for defining how manufacturers and test labs should measure the performance parameters of high-fidelity equipment, has standardized the specifications of amplifiers and is currently revising its FM tuner specification standards, but has never standardized any speaker measurement techniques, not even for speaker efficiency. So manufacturers don't advertise efficiency, magazine test reports have not generally measured efficiency, and the buying consumer is left in the lurch. Of course the IHF is a manufacturers' association, not a consumer-oriented body, and the IHF Standards Committee operates at the manufacturers' bidding. There is some disagreement among industry members about how best to measure speaker performance parameters, and apparently the IHF would rather leave consumers completely ignorant than specify tests which might produce a misleading result once in a while.

However there are four ways in which at least approximate values of relative loudspeaker efficiency can be obtained. I have used all of these in compiling the attached table.

(1) Since mid-1970 High Fidelity's speaker test reports have included response measurements in an anechoic chamber, taken all around the speaker at a microphone distance of 1 meter and processed with a, small computer to produce three response curves. One of these is the on-axis frequency response, but the curve of interest here is the solid line representing the speaker's total acoustic power output, for an electrical input of one watt, averaged over all directions. To represent the speaker's efficiency, I take the average output in the range from 100 Hz to 2 kHz (where most of the acoustic power in music occurs).

I add 3 db to the number obtained from High Fidelity's graph, and the resulting number turns out to represent with pretty fair accuracy the sound pressure level (SPL) obtained at an average location in a room of 2000-cubic-feet volume and moderately live acoustics, for a one-watt input. Then, knowing the SPL produced by one watt of amplifier power, the power required to produce a sound level of 100 db can be calculated from the equation: P = antilog (100 - SPL).

(2) Consumer's Union, whose reports on high-fidelity gear have to be taken with a grain of salt in some respects, do include in their loudspeaker evaluations a "required power" figure which can be taken as an indication of relative speaker efficiency. CU do not specify how their power figures are obtained, but I find that doubling their numbers gives results which agree roughly with the power figure for 100 db which I derive from High Fidelity.

(3) Estimates of relative efficiency can be obtained from comparative listening tests in showrooms or at home, but great care must be taken. If 8-ohm and 4-ohm speakers are compared and sound equally loud at the same volume control setting (or at the same reading on an amplifier's "power" meter), the lower-impedance speaker is actually absorbing more power and so is about 3 db less efficient. If equally efficient 8-ohm and 4-ohm speakers are compared, the 4-ohm speaker will sound louder at the same volume control setting. Another problem with listening comparisons is that a speaker with an upper-midrange peak will sound subjectively loud and so more efficient than it really is.

(4) Most loudspeakers obey a physical relationship between low-frequency response, cabinet size, and efficiency. This relationship was established about 15 years ago at Acoustic Research; Henry Kloss calls it Hoffman's Iron Law. It doesn't apply to speakers which contain "acoustic amplification," such as the Klipschorn and Heil's air motion transformer, but it does apply generally to closed-box loudspeaker systems. In a form practical for calculations it can be expressed as:

$$E \approx \frac{V F^3}{200{,}000\, Q}$$

Here E is the efficiency of the woofer in the frequency region where its response is flat; the efficiency is expressed as a percentage, and though the formula gives only the woofer's efficiency the tweeter's efficiency obviously will be matched to the woofer if the speaker sounds good. The V in the formula is the effective volume of the cabinet, in cubic feet. F is the resonant frequency of the woofer as mounted in the box (not the free-air resonance). Q is the reactance/resistance ratio at resonance; in practical terms it may be taken as a number which specifies the shape of the speaker's low-frequency response. A speaker with a Q of about 1 is approximately flat down to the resonant frequency. A Q much higher than one would mean a pronounced peak at resonance; with a Q of less than 0.8 the speaker's low end would start rolling off at about twice the resonant frequency. Many good speakers have a Q of about one. The equation indicates that such a speaker, with a resonant frequency of 45 Hz in a 2 cubic foot box will have an efficiency of about 1% (or worse if the design is not optimum). At that efficiency a speaker will produce a sound level of about 84 db at 1-watt input, in an average room.

Incidentally, the Iron Law explains the difference between the KLH-17 and the Smaller Advent alluded to earlier. The Smaller Advent has a lower woofer resonance (43 Hz vs 60 Hz) and a smaller cabinet than the KLH-17; it pays for its deep-bass performance and compact size with a loss of efficiency.

I have compiled the following tables using all of the above methods for obtaining values. Since the data derived from High Fidelity are the most precise (probably to within ± 1 db), those values are collected in the left-hand column. Data obtained from the other sources are listed in the right-hand column; they should be regarded as approximate and preliminary, and may not be reliable to better than ± 2 db. All values are rounded-off to the nearest whole decibel.

(High Fidelity)			(Other sources)		
SPL at 1 watt	Approx. power for 100 db.	Name	SPL at 1 watt	Approx. power for 100 db	Name
83 db	50 watts	AR LST	83 db	50 watts	AR 3a
82	60 w	AR 2ax	83	50w	AR 5
83	50 w	AR 6	83	50 w	Large Advent
84	40 w	AR 7	83	50 w	ADC 303A
81	80 w	Smaller Advent	85	30 w	ADC 303AX
86	25 w	ADC 303B	86	25 w	Altec 887A
84	40 w	ADC 450	88	16 w	Altec 892A
82	60 w	Audioanalyst A100	87	20 w	Altec 893B
84	40 w	B & 0 5700	82	60 w	Dyna A25
84	40 w	Bose 501	85	30w	DynaA35
86	2.5 w	Dyna A50	82	60 w	EPI 100
85	30 w	Dyna A 10	82	60 w	EPI 50
89	12 w	Empire 7500M	83	50 w	EPI 150
86	25 w	ESS Heil AMT-1	88	16 w	Fairfax FX300
87	20 w	ESS Transtatic I	88	16 w	Fisher XP65B
82	60 w	Fisher WS-80	87	20 w	Jensen 2
83	50 w	Fisher ST-550	86	25 w	Jensen 3
86	25 w	Frazier Mk VI	86	25 w	Jensen 4
82	60 w	IMF Monitor Mk II	90	10 w	JVC 5322
83	50 w	Infinity 1001	83	50w	KLH 5
85	30 w	Infinity T-L Monitor	87	20w	KLH 6
87	20 w	JBL 100	88	16 w	KLH 17
85	30 w	KLH 33	83	50w	KLH 32
90	10 w	Laf. Criterion 200A	83	50w	KLH 38
88	16 w	Leak Mk III	88	16 w	Laf. Criterion 4x
92	6 w	LDL 749	89	12 w	Laf. Criterion 5xa
89	12 w	Marantz Imperial?	87	20 w	Laf. Criterion 6
84	40 w	Onkyo 20	85	30 w	Marantz Imperial 5G
90	10 w	Pioneer R-700	83	50 w	Microacoustic 10
85	30 w	Tannoy Orbitus	86	25 w	R. Shack Optimus 1
83	50 w	Wharfedale W60E	86	25 w	R. Shack Optimus 5
			89	12 w	Pioneer R-300
			85	30 w	Rectilinear Mini-III
			87	20 w	Scott S-15