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AR90 OWNER'S REFERENCE MANUAL



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OWNER'S RECORD

For your convenience, future reference, and to help expedite any services needed in connection with your AR-90s, attach your sales slip to this page, record the date of purchase, serial number(s) and your dealer's name and address in the spaces provided below. Please make reference to this data any time you correspond with Acoustic Research. In the event that your AR-90s are ever lost or stolen, the availability of this information will be invaluable in the filing of an insurance claim and in the report required by your local authorities.

Serial Number(s)

Date of Purchase Day Month Year

Dealer Name

Dealer City & State

NOTE:

You will find the serial number of your speakers, on a tab, on the logo plate attached to the front panel of the enclosure, directly below the three upper-range drivers. To remove the front grille panel, grasp its two upper corners and gently, but firmly, pull outward. The grille panel will pivot on its lower edge and fall away from the lower grille-panel mounting sockets on the enclosure. To replace the grille panel, refer to instructions in the section "Installing and Removing the Grille Panels".



SERIAL NUMBER

A SHORT PREFACE

Your AR-90s are very-high-precision devices, designed and built to tolerances comparable only to professional studio microphones. They far exceed the performance capabilities of the classic Laboratory Reference Standard, the AR LSTs. All of the modern technology in speaker design, as well as the most sophisticated of computer techniques, were used, not only in their development, but continually throughout their design and manufacture. The three most distinctive applications of this technology in the AR-90s are the Acoustic Blanket,[™] the vertical, upper-range driver array, and the positioning of the two woofers, one on each side of the enclosure. The former two insuring unprecedented imaging and precision of localization and the latter unequalled flat frequency response in any listening environment, particularly at lowest music frequencies. Indeed, the clarity of the AR-90s will make you aware of limitations in associated equipment, including the finest electronics. As a result, any improvements in the chain preceding the AR-90s will seem to continually improve their overall performance.

Considering their complexity and sophistication, the AR-90s are easy to install and use. However, to be certain you derive total enjoyment from the performance of which they are capable, we strongly suggest you read this manual thoroughly. The information contained in it will be, we are sure, not only educational, but also will insure that your system will operate at the level of performance to which it was designed.

While the necessary connections should not take more than half an hour or so, you should take time to read through the manuals for each piece of equipment being installed to ensure that your system will operate to its full potential. This additional time will almost guarantee you many more years of enjoyment.

INSPECTING FOR DAMAGE

Although the carton and packing materials of your AR-90s were designed to protect them from the roughest handling in shipping, abuse or severe drops may cause injury to the cabinets or speaker elements. Therefore, while you are unpacking your loudspeakers inspect them for physical damage to the enclosures, and loose rattling parts. AR's careful attention to Quality Control insures that your loudspeakers left AR in perfect condition, so if any damage is evident, the following procedures must be followed. If your speakers were received directly from a dealer (if they were not shipped to you via a public transportation agency), you should notify the store where you purchased them immediately of any damage evident and request instructions on how to proceed. If they were received by you via public transportation, **report the damage at once, in writing, to the shipping company and request instructions for filing a claim in order to recover any charges that may be made for freight damage repairs. Please remember that freight damage is NOT covered by the Warranty. Under no circumstances discard any of the packing materials or reship your loudspeakers prior to an inspection by the carrier or unless advised to do so in writing by the shipping company. Please bear in mind that notification of damages must be made to the carrier in writing within 15 days of receipt. To ignore these recommendations may result in your forfeiting the right to all freight damage claims and, if so, you will gain no redress for expenses incurred in having the damages repaired.**

NOTE: Notification by phone to the carrier does not fulfill legal requirements. Notification must be made in writing preferably by Certified Mail.

INSTALLING AND REMOVING THE GRILLE PANELS

NOTE: Do not install the grille panels on the AR-90s until you have selected their final position in your listening room. It is recommended that you **NOT** attempt to move the speakers with the grille panels installed. If excessive pressure is applied to the edges of the grille panels while moving the speakers, you may shear off one or more of the mounting studs. Replacement of a sheared mounting stud is **NOT** covered by the Warranty.

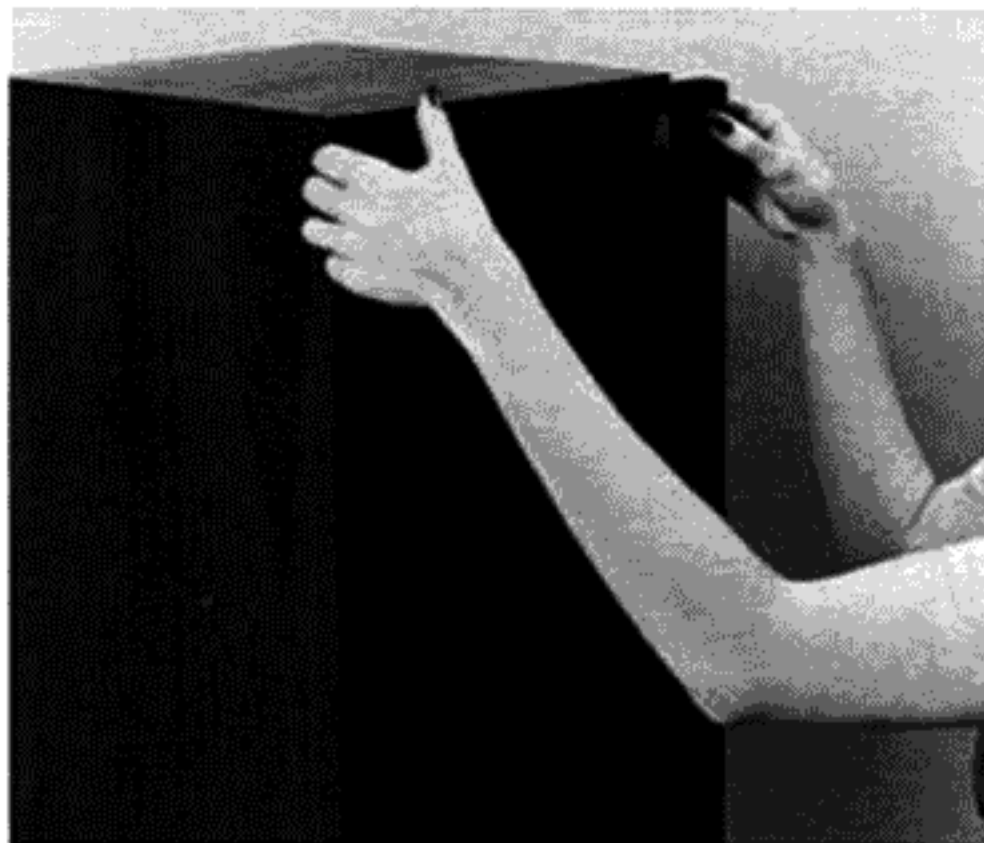
The three grille panels for each of your AR-90s (one for each woofer and one for the front panel) are packed separately in the long thin carton, within the outer box of the speaker. The grille-panel carton is located between the two cardboard pads along one side of the top and bottom caps for the speaker enclosure which act as cushions for the speaker in shipping. **Be careful, when opening this carton, particularly if you are using a knife or other sharp instrument, not to damage the thin cloth stretched over the grille frames.**

TO INSTALL THE GRILLE PANELS

1. Place the long grille panel over the front of the enclosure with the AR-90 logo upright and at the upper right-hand corner, so that the two top mounting studs on the rear of the frame rest on the two top corresponding mounting sockets on the enclosure.
2. Press the two top corners of the panel firmly until the top of the panel snaps into the mounting sockets.
3. Align the two bottom mounting studs on the rear of the frame with the corresponding bottom mounting sockets, then press firmly the bottom corners of the panel until it snaps into the mounting sockets.
4. Now press on all four corners to seat the panel firmly on all four mounting sockets and to make certain all the inside surfaces of the panel are in close contact with the front of the enclosure.
5. Place one of the short grille panels (they are both identical and interchangeable) over one of the woofers with the two diagonally trimmed corners toward the front of the enclosure, so that the two top mounting studs on the rear of the frame rest on the two top corresponding mounting sockets on the enclosure.
6. Press the two top corners of the panel firmly until the top of the panel snaps into the mounting sockets.
7. Align the two bottom mounting studs on the rear of the frame with the corresponding bottom mounting sockets, then press firmly the bottom corners of the panel until it snaps into the mounting sockets.
8. Now press the panel on all four corners to seat the panel firmly on all four mounting sockets and to make certain all the inside surfaces of the panel are in close contact with the enclosure.
9. Repeat steps 5 to 8 to install the second woofer grille panel.

TO REMOVE THE GRILLE PANELS

1. Grasp the two upper corners of the grille panel.
2. Gently, but firmly, pull the top of the grille panel outward. The grille panel will pivot on its lower edge and fall away from the two lower grille-panel mounting sockets on the enclosure.



AMPLIFIER RECOMMENDATIONS AND POWER HANDLING

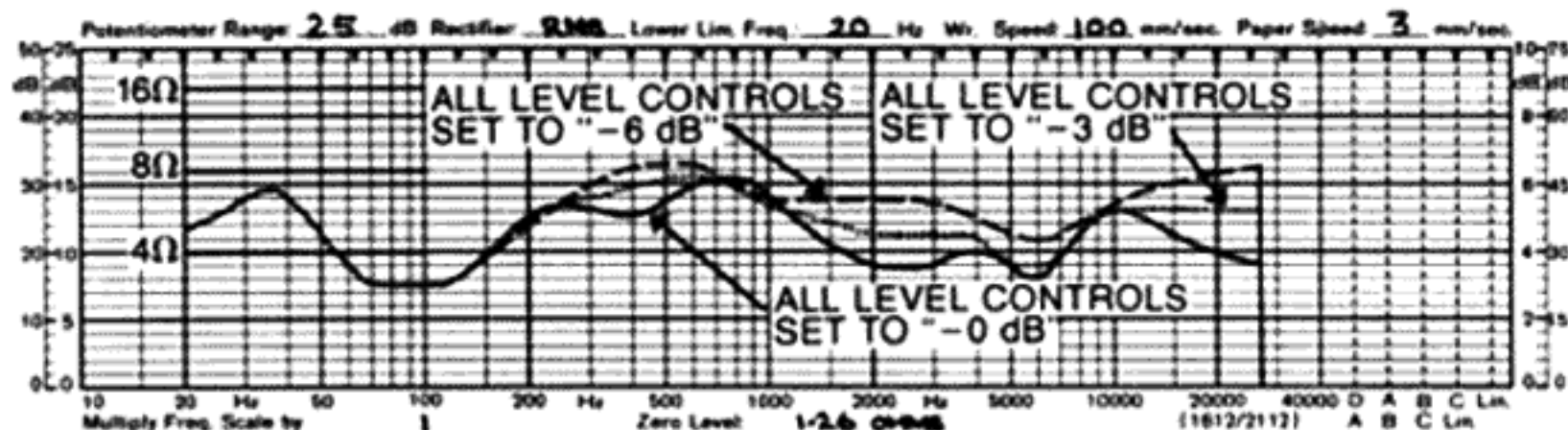
At the back of this manual you will find a chart listing all AR-90 specifications, power amplifier requirements and other pertinent technical data, which along with the typical impedance curves in this section, will aid in selecting the correct amplifier for your particular application. It should be noted here, however, that regardless of the power-output capability of the amplifier selected, only associated equipment of the highest quality is recommended for use with the AR-90s.

While all the information given under "Amplifier Power Requirements" are the minimum recommendations for average program material in a normal home environment, there are certain other situations and types of program material which will require much greater amplifier output capability. (Since present day recordings can have a dynamic range or peak levels approximately 10 to 15 times that of the average power being delivered to the speakers, a suitable amplifier with adequate reserve power should be selected if uncompressed reproduction of dynamics is desired and frequent amplifier "clipping" is to be avoided.)

NOTE: Amplifier clipping, or saturation, is a phenomenon which occurs when an amplifier is called upon to deliver more power to the loudspeakers than its output circuits or power supply can deliver. When viewed on an oscilloscope, the waveform peaks look as if clipped by scissors, hence the name. Amplifier clipping is a highly undesirable condition since it distorts the signal (from slight, barely audible distortion to great, depending on the amplifier and its recovery characteristics), feeds a great deal more energy than is present in the original program material into the upper midrange and highrange of the speaker and dramatically increases the average power delivered to the entire system by greatly reducing the original dynamic range. This situation is radically different from that encountered while playing music material in which most of the amplifier power is directed into the lower and upper midrange.

It should be pointed out that, in the selection of a power amplifier, it is best to select one which exhibits more power than may appear necessary at first. The reasons are simply that the slightest perceivable increase in power output is 3 dB (that is, only a doubling of the power output of an amplifier produces a clearly perceivable change in level). An increase in power of a few watts, from, say, 40 watts to 50 watts, all other factors remaining identical, is generally not audible under most circumstances. It is important to note that the sensitivity of the ear to volume changes follows a logarithmic curve so that if you would like to perceive or "hear" a music selection at a volume level twice that of an original arbitrary level, a tenfold increase in power is required (that is, if your amplifier is feeding to the speaker an average level of 4 watts with peaks of 40 watts, to perceive **double** that level you will need an amplifier capable of delivering to the loudspeakers an average level of **40 watts** with peaks of **400 watts**).

With these factors as reference, estimates of power requirements for your individual application can be easily determined if you consider that power requirements depend not only on the desired acoustic pressure levels, but also on the volume of the room, and on the amount of acoustically absorbent material in the room. For each 3 dB increase in required acoustic pressure level, the amplifier power must be



Logarithmic impedance plots of AR-90 for the three indicated upper-range level-control settings.

doubled. Also, a corresponding doubling of amplifier power is required if room volume is doubled and a 3 dB decrease in listening level is to be avoided. The quantitative effect of absorbent materials cannot be defined as easily. Because their effect is frequency selective and because most absorbent materials are effective mainly in the upper regions of the audio spectrum in which music-power density is not always at maximum, the presence of such materials may require careful setting of amplifier tone controls and speaker upper-range level-control switches but, in general, will not require an increase in amplifier power.

The chart also lists, in terms that are easy to determine and understand, the maximum power handling capability of an AR-90 on **conventional speech or music input material**. It does **NOT** imply continuous input of sinusoidal (where all the power into the loudspeaker is present at only one frequency) or other very-high-average-power waveforms.

NOTE: It should be stated clearly, that it is impossible for anyone to make a simple yet accurate statement of the power-handling capability of any loudspeaker, particularly a statement of continuous power handling of test signals, unless the conditions (as is the case with the DIN spec) are accurately defined and verifiable. No accurate power-handling specification can be made unless the spectrum and its density are known and the phase angle of the voltage and current as well as impedance versus frequency are carefully monitored and stated. Such measurements are generally well beyond the capability of most service labs' equipment. As a result, only very general statements can be made concerning speaker power handling since the music material played through loudspeakers and its spectral densities varies in almost astronomic numbers.

When using very-high-powered amplifiers and especially when bass boost or the "loudness" control is used, it is imperative that your record player's rumble be minimal and that **its suspension isolate it well from its environment**, particularly the surface on which it rests. Low-frequency noise (turntable rumble or "thumps" resulting from tonearm oscillation and caused by record warps, eccentricity or walking near the turntable) and/or acoustic feedback, even when subsonic, must be kept to a minimum. Otherwise, the woofers' cones and voice coils will tend to make excessively large excursions in their magnetic gaps. As a result, the response at low frequencies will become intermittently nonlinear, causing muddy or ill-defined music reproduction, and distortion may be audible during high-level passages if they also include low-frequency components. In severe instances, when excessive rumble and thumps are overemphasized by large bass boosts, or if the tonearm is dropped onto a record with the volume control substantially advanced, "bottoming" of the woofers' cones and voice coils, identifiable by a sharp "crack" from the speakers, may be experienced with subsequent rubbing of the voice coils in their gaps. Please note that such damage is **NOT** covered by the Warranty. Whenever any form of distortion is heard, generally one or more of the system's components is being operated well beyond its capability and the overall demand for sound level should be reduced if damage to some part of the system is to be avoided.

The AR-90s are designed to operate optimally with power amplifiers having a damping factor (DF) of 10 or higher. All other parameters remaining identical, very-high-damping factors will not in any way affect the low-frequency performance of the speaker system.

The AR-90s are designed to reproduce all types of music. However, they cannot generate constant deafening volume levels associated with discotheques in very large rooms and/or in very noisy environments without the risk of damage to some component in the system. Damage caused by such volume demands is **NOT** covered by Warranties and if these very-high-playback levels are desired or necessary in such environments, it is suggested that multiple speakers be used on each channel via series or series-parallel configurations. (The preceding incidentally is true of any wide-range, low-distortion high-fidelity loudspeakers made for home use.) Interestingly such volume levels can be achieved in the home only by driving receivers and amplifiers designed for home use into clipping and overload almost constantly and exceeding their proper operation points. It should be pointed out that speakers used during rock concerts and in discotheques are custom-designed, highly specialized speakers used specifically for sound reinforcement only and almost always used in large multiples.

NOTE: As is the case with loudspeakers designed for home music reproduction, the AR-90s should not be fed sine waves, or other test waveforms from a generator, test record or other sources at high level or for prolonged periods of time. Test signal inputs should never exceed 6 volts RMS (a very moderate listening

level) or a duration of three minutes. (It is a little known fact that a pure sine wave of a given amplitude will be perceived by the ear at a level lower than that of a complex waveform of equivalent RMS amplitude.) To exceed this recommendation may result in thermal overload of the voice coils which can cause damage to the speaker **NOT** covered by the Warranty.

CONNECTING THE LOUDSPEAKERS

Each of your AR-90s is equipped with an input terminal plate recessed into the rear panel of the enclosure. Connection to the speaker system itself is made through two "five-way" binding posts, color-coded red and black (for "+" and "-" identification, respectively)—so you may not need tools if you are using ready-made cables with terminal wire ends, spade lugs, professional "GR" connectors or "banana" plugs. The correct wire and connectors will generally be available from your dealer (or any large electronics supply house) at reasonable cost. The five-way binding posts will facilitate connection to the loudspeakers and reduce the possibility of shorts and loose connections.

When making connections to the loudspeakers from the amplifier, it is very important to use the correct type and size of wire in order to avoid unnecessary loss of amplifier power in the cable and reduction of amplifier damping factor (DF). For runs under 12 feet, ordinary "zip" or lamp cord, made of # 18 stranded wire and obtainable in a variety of insulation colors may be used. For runs up to 40 feet # 16 stranded wire must be used to prevent power losses. For lengths over 40 feet, and not exceeding 60 feet, use # 14 stranded wire only. Runs exceeding 60 feet require the use of # 12 stranded wire. It is recommended, whenever connecting loudspeakers, that you always use a single run of wire without splices or joints. If this is not possible, however, be certain when splicing two lengths of wire that the two ends of the coded and uncoded conductors are spliced to each other and not cross-coupled, or, then, you inadvertently may be connecting the speakers out of phase (see sub-section "To Connect the Loudspeakers", below). It is advised, whenever wires are spliced together, that you solder the splices and carefully insulate each splice in both conductors with good quality PVC electrical tape.

If you wish to verify that your loudspeakers are in phase, once connections to the amplifier have been made, play a recording of solo voice with single instrument accompaniment at normal volume with the amplifier's mode switch in the mono or A + B position. Stand about two feet in front of the loudspeakers and exactly between them. If your loudspeakers are in phase, the voice and accompanying instrument will appear to originate from a point directly in front of you and exact localization will be fairly easy. If you now move a foot or two to the left and to the right of your previous position, the singer and instrumentalist will still appear to come from a point directly in front of you. If your loudspeakers are out of phase, the image of the performers will be imprecise and will be difficult to pinpoint. Depending on your room, the image may appear to be coming from behind you, or the sound will seem to surround you, and, as you move left and right from your center position, the origin of the sound will seem to change instantaneously. Should your connections have resulted in an out-of-phase condition, simply reverse the leads on **one** of the loudspeakers—that is, switch the wire connected to the red binding post on the loudspeaker to the black binding post and vice-versa. Repeat the listening test with the mono signal to make sure you were correct in your initial evaluation. If you can now achieve a precise and stable image of the singer and instrument between the two speakers, make that connection to the speakers permanent.

Whenever possible, and if you have the tools, it is suggested that the wire to the loudspeakers and to the power amplifier's outputs be tinned to facilitate connection and to prevent shorts.



TO STRIP AND TIN THE WIRES

1. Measure as accurately as possible the length of wire necessary to interconnect each speaker to the amplifier or receiver. Be certain to anticipate the path around furniture, corners, etc.
2. After the wire is cut to length, split the insulation about 3 inches to separate both conductors at the ends of each cable.
3. Strip about $\frac{5}{8}$ of an inch of the insulation off the wire, being careful not to cut into the wire strands.
4. After twisting each of the conductors to prevent loose strands, tin the ends of each conductor with solder and a soldering iron. Do not use excessive solder on the wire. Run the hot iron up and down the conductor end to insure good, even solder flow into the strands.
5. Tip the conductor end down to permit excess solder to flow out onto the hot, soldering-iron tip and away from the strands.

TO CONNECT THE LOUDSPEAKERS

1. Determine the coding used in your wire to identify the conductors. All double-conductor cable is supplied with a means of identifying the conductor at either end. Some wire is furnished with a coding ridge or flat along the edge of the insulation of one of the conductors. Other wires have a colored-thread tracer inside the insulation or internal color coding (one conductor is copper, the other silver).
2. Connect one of the cables to the left speaker by securing the conductor with the tracer or identification to the **red** binding post on the loudspeaker. Connect the unmarked conductor to the **black** binding post. The easiest way to secure the wire to the binding post, once its end has been twisted or tinned, is to unscrew the colored-plastic knurled nut, feed the wire through the hole in the binding post, so that the end of the insulation is at the edge of the "shoulder" of the binding post, and screw tightly the colored-plastic knurled nut, squeezing the wire between the bearing surface of the shoulder and the plastic knurled nut. (To insure good contact between the wire and the bearing surface of the shoulder of the binding post, the wire insulation must be off the bearing surface.) If it is not possible to feed the tinned end of the conductor through the hole in the binding post, due to the size of the cable you are using in your installation, simply form a "hook" on the stripped, tinned end of the conductor, place it on the stud of the binding post so that the end of the insulation is at the edge of the shoulder of the binding post and screw tightly the colored-plastic knurled nut, squeezing the conductor end between the bearing surface of the shoulder and the plastic knurled nut. If the wire is provided with spade terminals, slide the "U" of the spade onto the binding post and screw tightly the colored-plastic knurled nut squeezing the spade lug between the bearing surface of the shoulder and the plastic knurled nut.

If your cables are provided with GR connectors or banana plugs, first make certain the red- and black-plastic knurled nuts are screwed down tightly and plug the GR connector or banana terminal into the sockets provided in the center of the five-way binding posts.

3. At the other end of the left-speaker cable, secure the conductor with the tracer or identification to the amplifier's or receiver's left-channel speaker-output screw terminal or binding post labelled 8 OHMS*, POS, "+" or color-coded red. Connect the unmarked conductor to the left-speaker output terminal labelled NEG, C, COM, COMMON, "-", G, GROUND or color-coded black. Do not confuse the special turntable-ground terminal, generally placed on the chassis, well away from the amplifier's speaker outputs, for the negative or common loudspeaker-output connection. If you are in doubt, please consult your amplifier or receiver Owner's Instruction Manual.
4. Connect the conductor with the tracer or identification of the second cable to the right speaker by securing it to the **red** binding post. Connect the unmarked conductor to the right-speaker's **black** binding post.
5. At the other end of the second cable, secure the conductor with the tracer or identification to the amplifier's or receiver's right-channel speaker-output screw terminal or binding post labelled 8 OHMS*, POS, "+" or color-coded red. Connect the unmarked conductor to the right-speaker output terminal labelled NEG, C, COM, COMMON, "-", G, GROUND or color-coded black.

*Most vacuum-tube amplifiers use impedance matching transformers and a few transistor-amplifier designs are provided with auto-transformers at their outputs. Generally, these amplifiers have a selection of impedance "taps". These are always labelled with the value of the speaker impedance they are designed to match (16, 8, 4, etc.). In these cases, the connection to the speaker should be made to the proper channel of the amplifier's screw terminal or binding post labelled 4 OHMS.

NOTE: The most important point in phasing loudspeakers is that they both be connected identically at both ends of the cable—that is, that the conductors connected to the red binding posts on both speakers be attached to corresponding contact points at the amplifier or receiver outputs (e.g. screw terminals or binding posts labelled 8 OHMS*, "+" or color-coded red).

6. Carefully examine all the connections to the loudspeakers and receiver or amplifier loudspeaker-output terminals to see that all connections are firm, that no wire is frayed and to make sure no loose strand from any conductor is touching another conductor, other binding post, other output terminal or other metal part of the receiver or amplifier.

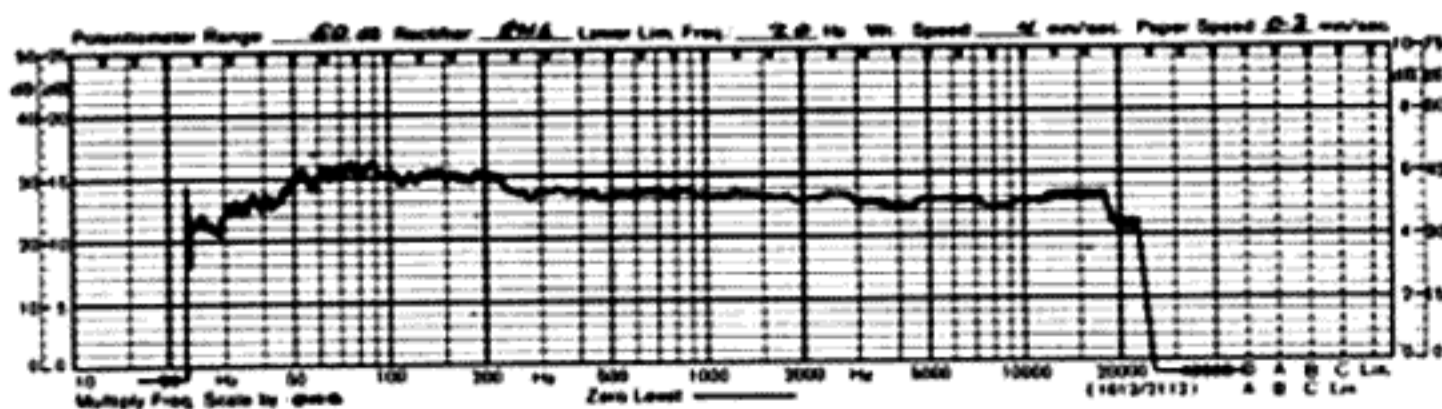
NOTE: It will be difficult in some instances, depending on the gauge of the wire used, to make connections to the speakers' binding posts and the amplifier outputs if the correct spade lugs or connectors are not used. Any electrical supply house should have available a variety of spade lugs with studs to fit any size wire, and spades of all widths to fit almost any screw terminal in an amplifier and binding post on a speaker, without the danger of shorting the terminals or adjacent lugs. Two manufacturers offering such lugs are AMP and VACO.

You may wish to enhance the appearance of your installation, if your listening room is situated above a basement area, by drilling a small hole in the floor, running your speaker cables beneath the floor and bringing them up through another small hole drilled behind or near the speakers, thus concealing any visible wires. If you prefer to run your wires along a baseboard for a neater installation, there are many inexpensive staplers available which are designed specifically for stapling wire to baseboards and walls. Be careful, however, when stapling or tacking wire, not to cut through the insulation and short the conductors together. Shorted wires may cause intermittent or distorted operation of the amplifier or receiver and damage to its output stages.

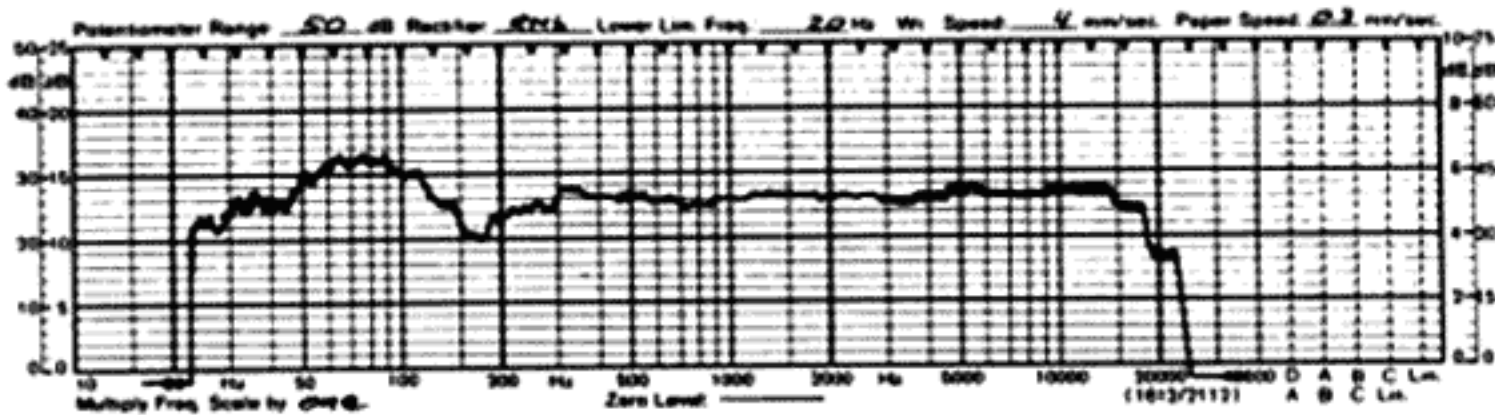
*See footnote on page 7.

PLACING THE AR-90s IN YOUR ROOM AND ROOM ACOUSTICS

The design of the AR-90s, and in particular the location of the woofers in the enclosure plus their relative position with respect to the reflective surfaces in a room, will insure unprecedented flat response in the bass range. In general, the best positioning of the AR-90s in a listening room, for maximum smoothness of the bass and upper bass, will be found to be that where the rear panel of the enclosures are not more than 2 inches from the short walls of the room, and with the outside woofers at least 3 feet from the nearest side wall.

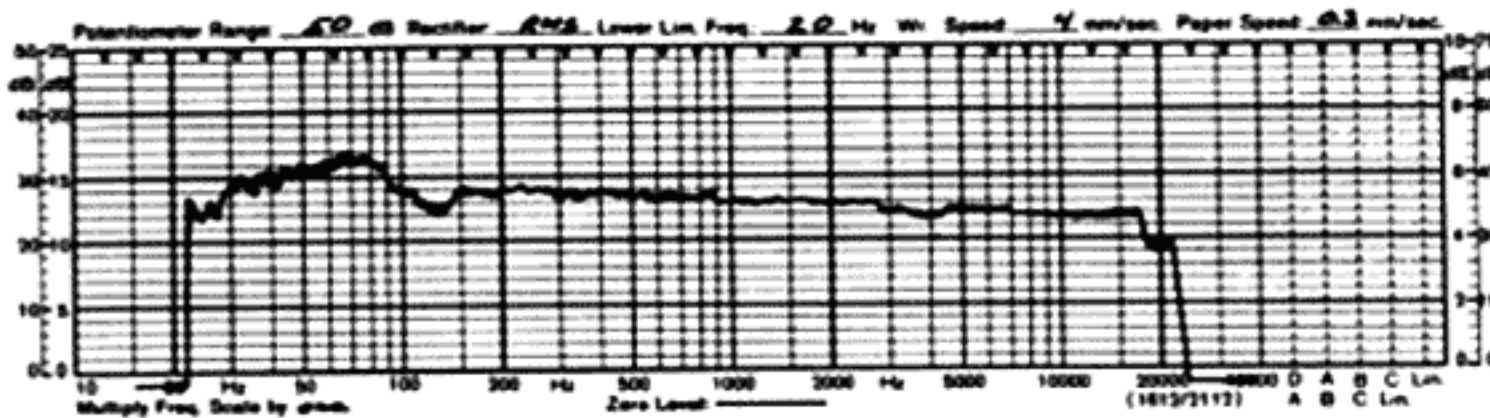


Spectral energy profile of an AR-90 in a typical listening room with the rear panel of the enclosure against the rear 15½-foot wall, its right woofer approximately 5 feet from the right-side wall and its left woofer approximately 9 feet from the left-side wall. Note the smooth response in the bass region and the absence of serious peaks and dips.

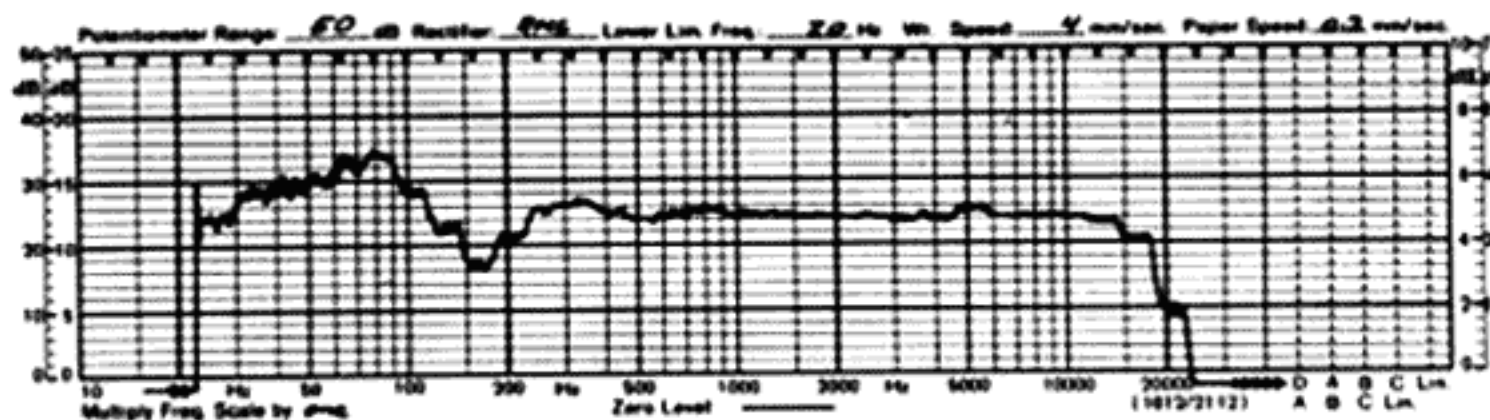


Spectral energy profile of a conventional speaker with a single, front-facing woofer in the same location as the AR-90 above. Note the 12-dB peak-to-trough ratio in the energy level between 50 Hz and 200 Hz which is absent in the AR-90 profile above.

Placement of the AR-90s closer to the side walls than 3 feet will cause a slight loss of energy in the region around 125 Hz and a slight boost in bass below 100 Hz. This effect, however, is easily correctable with the bass control of the amplifier and is negligible in comparison to the effect on the spectral energy profile of a conventional, front-facing, single-woofer system.

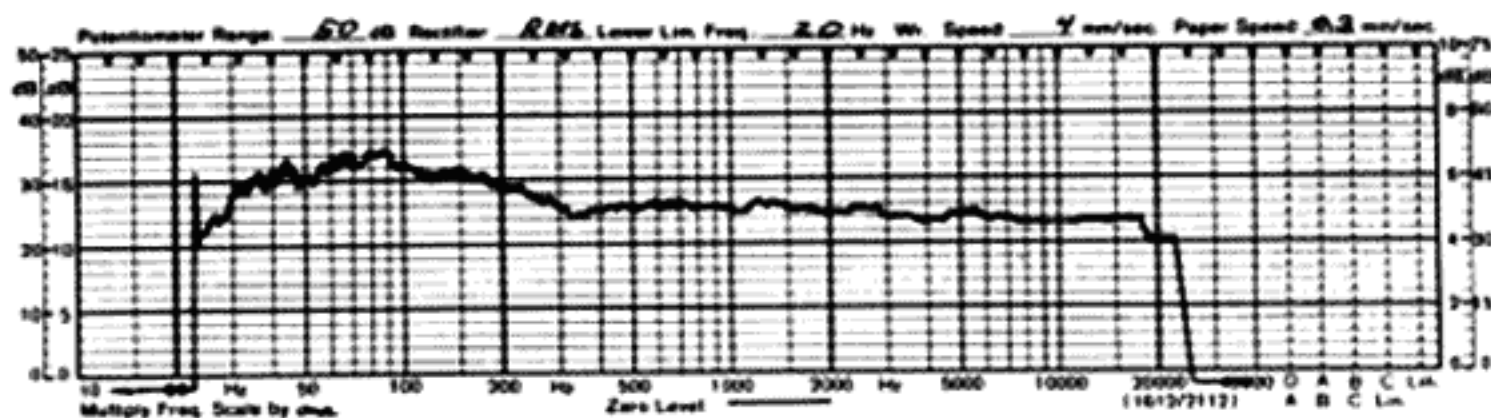


Spectral energy profile of an AR-90 in a typical listening room with the rear panel of the enclosure against the rear 15½-foot wall and its left woofer approximately 20 inches from the left-side wall.

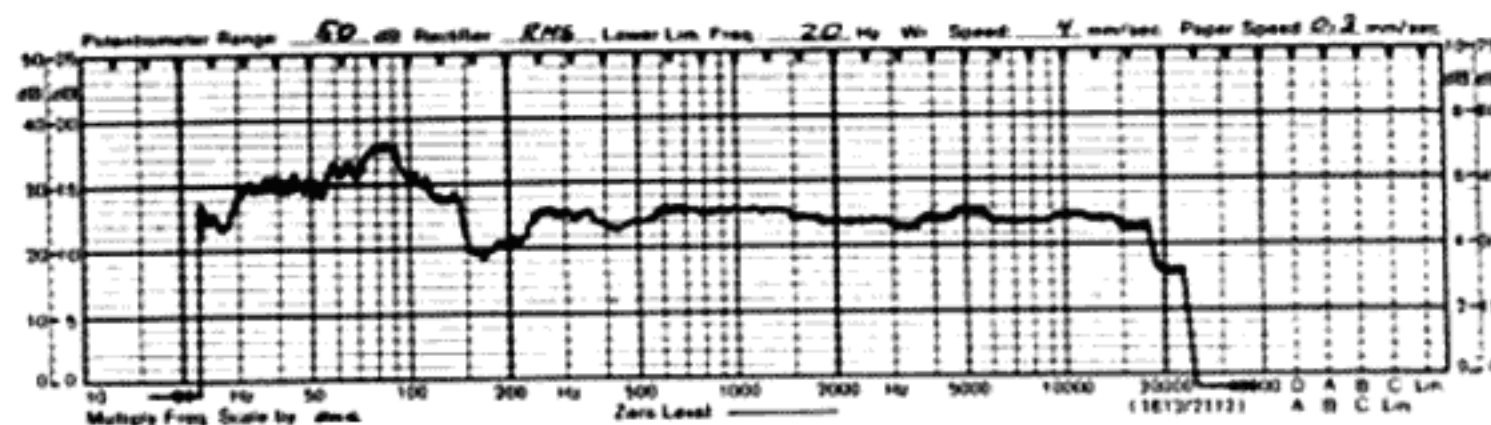


Spectral energy profile of a conventional speaker with a single, front-facing woofer in the same location (20 inches from the left-side wall) as the AR-90 above. Note the 20-dB peak-to-trough ratio in the energy level between 50 Hz and 200 Hz which is minimal in the AR-90 profile.

The AR-90s may be placed in even seemingly extreme positions in your room (such as one with the speakers catercornered on either side of the room) with relatively slight effects in their response when compared to the gross variations in the response of a conventional, front-facing, single-woofer system. Again, with the AR-90s, the progressive response anomalies are easily correctable through use of the bass control on the amplifier.



Spectral energy profile of an AR-90 in a typical listening room with the speaker catercornered and the rear panel at an angle to the rear 15½-foot wall.



Spectral energy profile of a conventional speaker with a single, front-facing woofer in the same location (speaker catercornered) as the AR-90 above. Note the up-to-18-dB variations in the energy level and rough response extending from 40 Hz to 600 Hz.

It is suggested, if at all possible, that you place the two AR-90s asymmetrically in your room to insure the smoothest frequency response and to minimize the effect of standing waves in your room. Whenever loudspeakers are placed symmetrically in a room, strong reflections from room surfaces (walls, floor and ceiling) at certain frequencies reach the listening position (and, for that matter, the woofers in the two systems) in a phase different from that of the direct output from the speakers and reinforcement and partial cancellation of energy will result. The exact frequencies at which this phenomenon occurs will depend on the distances between the speakers, the listener and the reflective surfaces, but is always a low-frequency phenomenon.

NOTE: In some rooms, and depending on the dimensions of the room involved, you may experience some low-bass cancellation. Generally, this effect will occur in the very-low-bass region, from below 30 Hz to slightly above 40 Hz. Although this phenomenon is present with all speakers, it is most noticeable with the AR-90s due to their extended bass response and the smoothness of their spectral energy distribution. In such instances, it is especially recommended that asymmetrical placement of the speakers in the room be employed to minimize the cancellation you may have experienced in an initial location. The greater the loss of low-frequency energy, the greater the asymmetry in placement must be to reduce the cancellation effect. In instances where the loudspeakers cannot be placed asymmetrically, an asymmetrical listening position will be of substantial help.

It should be noted here that the placement of furniture in the room will be of little consequence to the bass response of AR-90s and furniture may be placed near or next to an AR-90 with no effect on the performance so long as the radiation of the upper-range drivers is not impeded by high-backed chairs, and structures such as bookcases are not in the line of sight between the upper-range drivers and the listener. However, it is not recommended that the AR-90s be placed behind drapes, screens, etc., since absorption of high-frequency energy will always occur.

There is no special formula to determine minimum and maximum separation of the loudspeakers, but two general observations may help you decide on an initial placement for your speakers. The minimum separation of the speakers will be determined by their distance from your favorite listening position. The area of stereophonic perception will broaden as the speakers are moved apart up to a point where you become aware of two separate sound sources—with no blend of the speakers and a "hole-in-the-

middle." If you are in doubt, a distance of 6 feet between speakers is a good one to begin with and, in most situations, will prove optimal as long as the listening area is centered between the speakers and its distance from the speakers is greater than 3 feet. Unfortunately, the inaccurate impression persists that, for proper stereophonic reproduction, there is only one placement for correct interaction between the loudspeakers, the room and the listener. This is perhaps the result of a basic misunderstanding about the advantages of stereo. The primary benefits of stereophony are the sense of depth, detail, acoustical spaciousness and instrumental choir definition possible through the use of two separate channels. A listener is able to follow individual lines of music and speech, and profits from the ambience of the hall in which the performance originally took place. Although these benefits are perceptible to some extent even when the speakers are placed in the worst possible arrangements, it is relatively simple to find loudspeaker locations that will project a satisfactory sense of spaciousness over the main listening area and beyond.

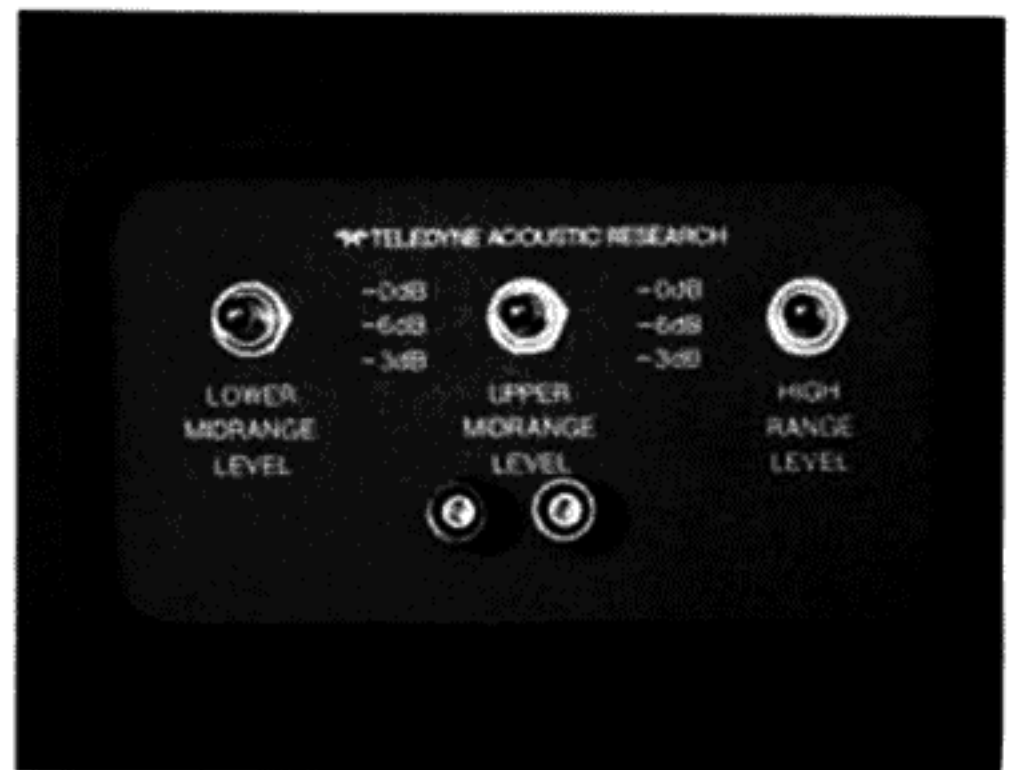
The simple rules above make it reasonably easy to find the best positioning of your AR-90s for stereo. Keep in mind that your own tastes and furnishings plus the recommendations for placement to achieve smoothest bass response—rather than any set or arbitrary requirements—determine the best arrangement. Listen long enough to decide which placement is most preferable and when you have made a decision, move the speakers a foot or two to make certain no noticeable improvement is possible. The idea is to achieve a smooth transition from bass through midrange to treble without preponderance or accentuation of the bass. Smooth bass response, in long-term listening situations, will generate the least "listening fatigue" and will result in the most enjoyable, most natural performance.

ADJUSTING THE UPPER-RANGE LEVEL CONTROLS

Each of your AR-90s is equipped with level-control switches for adjustment of the lower midrange, upper midrange and highrange. The switches are located on the input terminal plate recessed into the rear panel of the enclosure. The positions on the switches are labelled " -0 dB", " -3 dB" and " -6 dB" and indicate the absolute reference acoustic output of the driver they control. These level controls are designed to permit matching of the complete midrange and treble of the speakers to your individual room environment and are meant as important adjuncts to the tone controls in your receiver or amplifier. Therefore, make certain when setting these switches initially that your amplifier tone controls are placed in the flat or "0" position, that the loudness control is off and that the speakers are in their permanent position in the room.

In most rooms and situations in which there is normal acoustical absorption and treble diffusion effected by drapes, shelves, bookcases, furniture, etc., and where associated equipment and source material of very high quality are being used, the switches should be placed in the " -0 dB" position.

In rooms that are paneled, where hard surfaces abound, in sparsely furnished rooms, or if very bright-sounding source material is normally used, you may find that the " -3 dB" or " -6 dB" positions of the upper-midrange and highrange switches will result in best overall music balance. In rooms the dimensions of which impart a hollow, "barrelly" quality to the sound, you may determine that the " -6 dB" position of the lower-midrange switch is best.



NOTE: If you are using a very-high-power amplifier and **habitually listen at very loud levels**, it is recommended that you simply leave the switches in the “-0 dB” position to avoid excessive heating of the resistive networks which control the absolute acoustic output of the upper-range drivers. At extremely loud levels you are probably best served by using the treble controls of your amplifier or receiver to modify the spectral energy profile of the loudspeakers to your taste and room.

It is easy to determine the specific sonic character of your room. If your voice sounds dull and muffled, or if you clap your hands and the sharp sound seems lifeless, you probably have an over-damped, acoustically dead room. If when you speak, your voice is very reverberant (much like singing in the shower), and your hand clap causes “flutter echo” (a tick-tick-tick sound caused by the mid and high frequencies being reflected by hard, parallel surfaces), you probably have a very live room. The norm, of course, lies between these two extremes.

To liven a dead room, all that is required is to open drapes and expose some window glass. A few glass picture frames around the room and a hard-surfaced coffee table will also liven it up substantially.

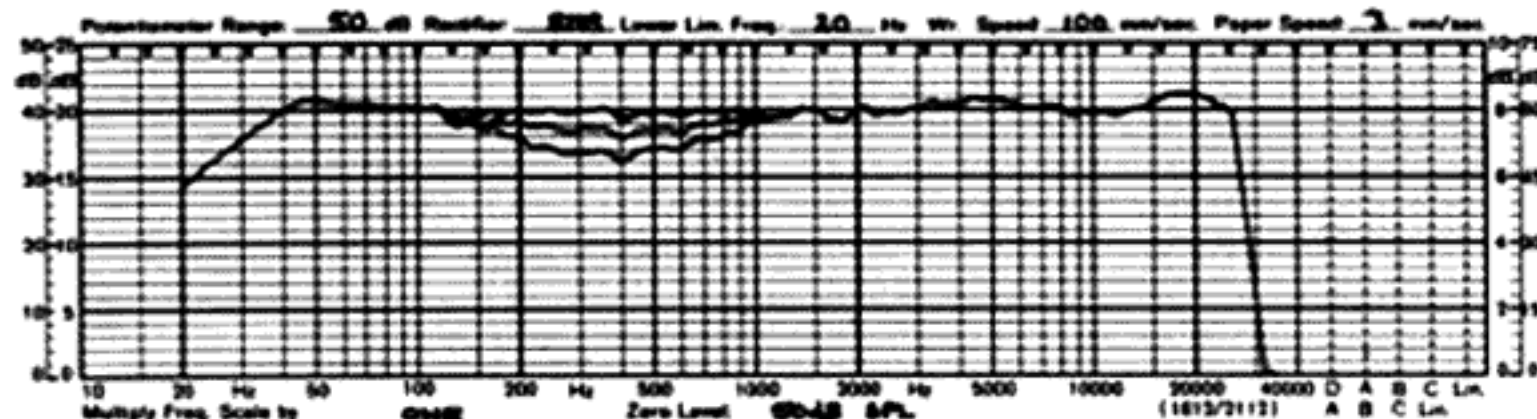
To tame an over-reverberant room, a few throw rugs on the floor and a bookshelf or two, along with mounted posters on the wall, will serve to break up most flutter echo situations, both medium-low and medium-high in frequency. Always try to place shelves or posters asymmetrically so that a bare wall on one side faces a poster or shelf on the other. The idea is to have a hard surface face a “softer”, less reflective surface across the room.

The correct setting of the lower-midrange, upper-midrange and highrange switches in your particular environment is that which will result in the best balance from bass through lower and upper midrange to treble without a preponderance of any part of the range being evident.

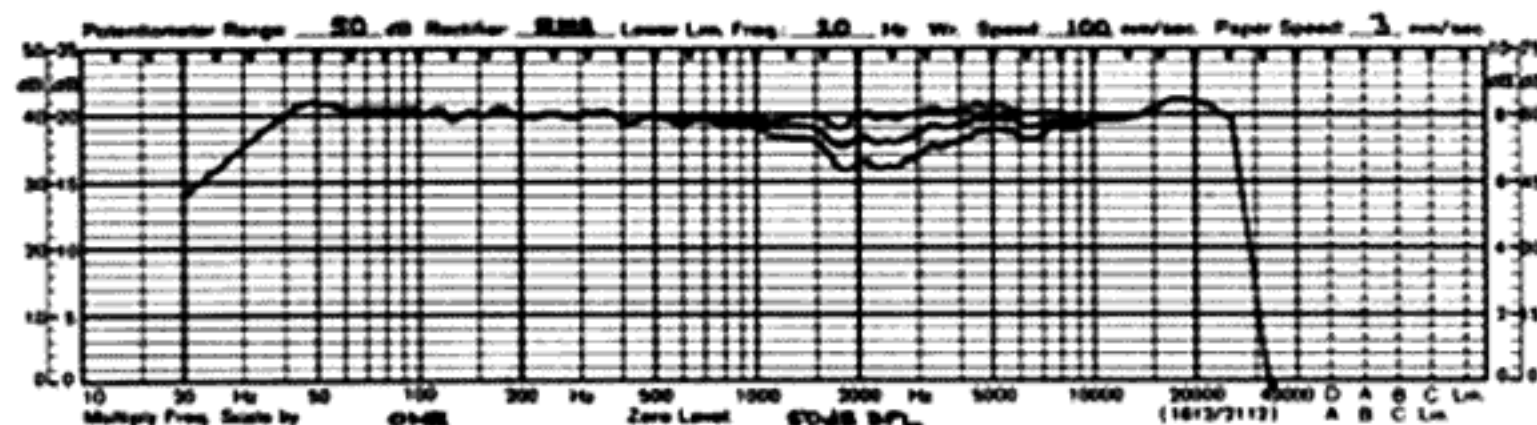
To help guide you in setting the switches properly, refer to the curves below which graphically illustrate the effect of each position of each switch on the absolute acoustic output of its driver.

AR-90 RESPONSE CURVES SHOWING EFFECTS OF THE UPPER-RANGE CONTROLS

ALL PLOTS ABOVE 200 Hz WERE MADE IN A 2π ANECHOIC CHAMBER WITH THE MICROPHONE ONE METER ON THE AXIS OF THE UPPER-MIDRANGE DRIVER. ALL PLOTS BELOW 200 Hz WERE MADE IN A π OUTDOOR ENVIRONMENT.



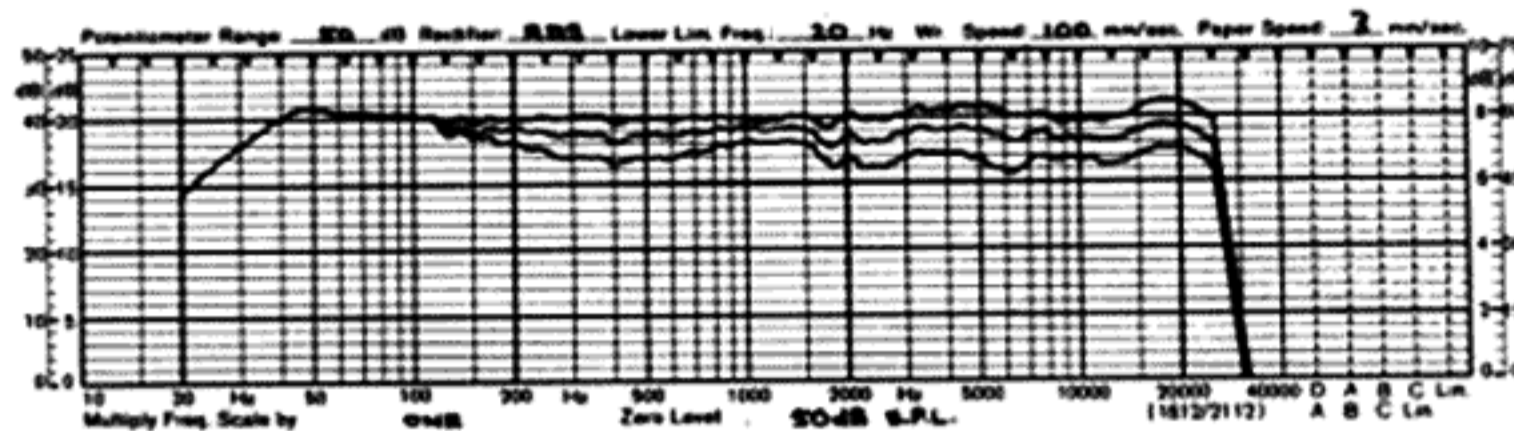
Effect of lower-midrange control on the absolute acoustic output of lower-midrange driver when it is set at “-0 dB”, “-3 dB”, and “-6 dB”.



Effect of upper-midrange control on the absolute acoustic output of upper-midrange driver when it is set at “-0 dB”, “-3 dB”, and “-6 dB”.



Effect of highrange control on the absolute acoustic output of highrange driver when it is set at "-0 dB", "-3 dB", and "-6 dB".



Effect of all the upper-range controls on the absolute acoustic output of the upper-range drivers when each control is set at "-0 dB", "-3 dB", and "-6 dB".

The easiest way to reach the most satisfactory setting of the upper-range controls is to adjust one speaker at a time rather than to try and make simultaneous adjustments to a stereo pair. Before you begin the adjustment procedure described below it may be helpful to note that, in many instances, the speaker switches for lower-midrange, upper-midrange and highrange control may not be at the same setting in both channels. That is, one speaker's upper-midrange control may be optimally set at, say, "-3 dB", while the other might require a "-0 dB" or "-6 dB" position. This type of occurrence is perfectly normal and is due to the differences in the immediate acoustical environment to the speaker. For example, one speaker may be placed close to a drape while the other speaker may be next to a wall with little absorptive material.

TO ADJUST THE UPPER-RANGE LEVEL CONTROLS

1. Set the mode switch of your amplifier or receiver to the mono or A + B position.
2. Rotate the balance control fully clockwise or counterclockwise so that only one loudspeaker is operating.
3. Select a number of recordings with which you are familiar and which are of as high-a-quality as possible. Among these should be recordings of massed cello, solo cello, or bass or baritone voices singing in their lower registers, piano, woodwinds and female voice, solo violin, guitar, massed violins, brass and cymbals.
4. Start playback and comparison of the recordings through the single loudspeaker, with all the upper range switches in the "-0 dB" position, until you are thoroughly familiar with the overall sonic character of the speaker in your room.
5. Before setting the lower-midrange switch, first place the other switches at "-6 dB."
6. Select and play recordings rich in lower-midrange material such as solo cello, massed cello, bass or baritone voices singing in their lower registers and slowly change the position of the lower-midrange switch to "-3 dB", "-6 dB" and back to "-0 dB" until you feel you have achieved, in one position of the switch, a smooth transition from the lowest bass through the upper bass to the lower midrange. Leave the lower-midrange switch in the position you have selected as best.
7. Select and play recordings rich in upper-midrange material such as piano, woodwinds and female voice and slowly change the position of the upper-midrange switch to "-3 dB", "-6 dB", and back to "-0 dB" until you feel you have achieved, in one position of the switch, a smooth transition from low bass through to

upper midrange and there is no preponderance of any part of the midrange or bass. Leave the upper-midrange switch in the position you have selected as best.

8. Once you have set the midranges satisfactorily, adjust the highrange switch similarly using solo violin, massed violins, brass, female voice and cymbals, noting particularly the transition from upper midrange to treble. Check that there is no preponderance of instrumental harmonics, sibilants, etc., and that you are not particularly aware the highrange is operating.

9. Rotate the balance control on the amplifier or receiver fully in the opposite direction to operate the other loudspeaker.

10. Repeat steps 4 to 8 above to adjust the controls on the second speaker.

11. Return the amplifier's mode switch to the stereo position, place the balance control in its "0" or normal position and make any other adjustments to the tone controls and loudness control you may feel are desirable.

FUSING THE AR-90

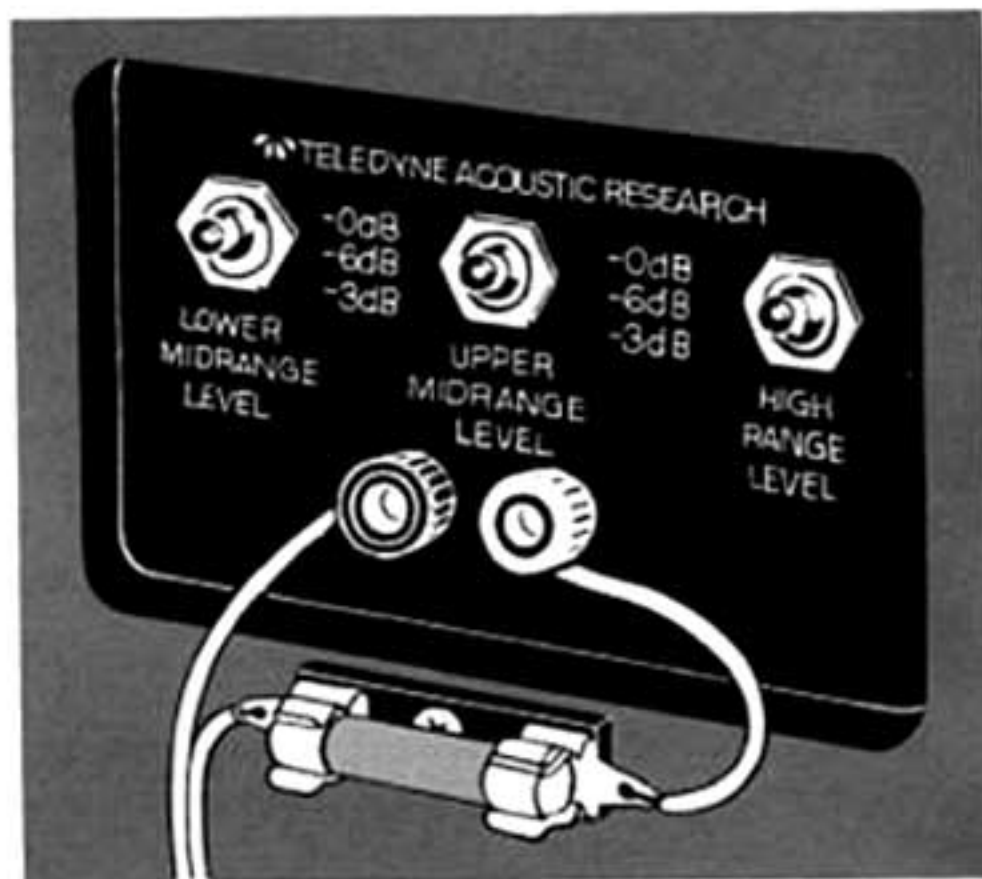
The AR-90s can handle easily the output of an amplifier of almost any power rating while playing music in a normal home listening situation and within the limits stipulated in the specifications chart at the end of this manual. There are abnormal conditions, however, under which your speakers may receive far more **average** power than they can tolerate. A few such situations may occur:

1. When the system is subjected to uncontrolled or unprofessional frequency-response testing.
2. If your amplifier develops a defect.
3. If your tape deck or recorder generates large amounts of ultrasonic power when in the fast-forward or rewind modes.
4. When you exceed the output-power capability of the amplifier so that it clips and distorts excessively.
5. When the loudspeakers are used in a discotheque application in which the demands for overall volume levels far exceed all normal listening levels.
6. When you feed the loudspeakers waveforms from a synthesizer at very high levels, or any other waveform whose average level is much greater than that of music waveforms.

If you wish to protect your speakers from thermal overload and stress due to most abnormal inputs, the fuse we recommend is the Buss Fusetron Dual-Element-Type FNM-2. This fuse will permit the following power levels to be fed into each loudspeaker without blowing of the fuse (all power levels below were calculated on the basis of a 4-ohm nominal impedance):

- 25 watts long-term average
- 64 watts for 30 seconds
- 180 watts for 10 seconds
- 400 watts for 5 seconds
- 800 watts for 1 second

To operate properly, this type of fuse must be mounted in an open fuse holder, not a cartridge-type fuse holder. Specifically, we recommend the Buss Fusetron #4421 which should be connected in series with one of the leads from the amplifier (see sketch for a typical hookup). The fuse holder may be attached permanently to the rear panel of the loudspeaker enclosure with a 3/4-inch, flathead, #8 wood screw. It is



advisable to drill a pilot hole for the screw before mounting or at least make a screw-starting hole with an awl or heavy nail.

NOTE: If you are using a drill to make a pilot hole, be careful not to drill into the rear panel more than $\frac{1}{8}$ of an inch. There are crossover components mounted onto the rear panel and, if the drill is permitted to completely perforate the rear panel, there is danger of damage to a crossover component with consequent malfunction of the speaker. This type of damage is NOT covered by the Warranty and will require the return of the entire loudspeaker to the AR factory. Under no circumstances attempt to mount the fuse holder with a screw or other device on the input terminal plate recessed into the rear panel of the speaker enclosure. There are crossover components also mounted on the inside of the input terminal plate which may be punctured by a screw tip or similar device, the replacement of which will again require return of the entire loudspeaker to the AR factory. In addition, the material from which the input terminal plate is manufactured will not firmly hold a screw or fuse holder. The result will be that the seal of the enclosure will be compromised.

Should the recommended fuse blow frequently, interrupting operation of one or both speakers, the indication would be generally that the power output capability of the amplifier is being exceeded or that one or more parts of the system is not operating properly.

Please note that there is no fuse which can safeguard a loudspeaker from every type of overload. Even the specialized fuse recommended will not protect the speakers from short-term, very-high-peak-power inputs. It will not protect the woofers, for example, if the system is plugged into an AC wall outlet. Nor will it prevent speaker damage if your amplifier feeds a large-amplitude "thump" to the speaker during turn on or turn off. Also, it will not safeguard the speaker from damage if you drop the stylus onto a record with the volume control advanced substantially when you are using a very-high-power amplifier.

NOTE: It should be pointed out here that cumulative damage may be caused to the speakers if very frequent and continual blowing of the recommended fuse is experienced. This would be the case if the amplifier were clipping excessively and causing the fuse to blow. When demands for higher levels than an amplifier is capable are made, the amplifier saturates or "clips"—a condition which causes the generation in the amplifier of a large number of harmonics not related to, nor present in, the original music material. The harmonics, depending on the frequency at which clipping occurs, cause the amplifier to distort (from slight, barely audible distortion to great, depending on the amplifier and its recovery characteristics) and deliver most of its output to the highrange of the speakers. A clipping amplifier also dramatically increases the average power delivered to the entire system by greatly reducing the original dynamic range of the music material, thereby increasing the thermal stress on the lower-midrange and upper-midrange drivers as well. Since the design of good highrange drivers requires a light voice coil and small diaphragm, these drivers are unable to dissipate the large amount of power constantly fed to them under these conditions and will eventually fail. Damage can be caused even by a modest-power-output amplifier since all or most of its power will be delivered into the highrange under these circumstances. In fact, more-modest-power amplifiers are the most likely to cause this type of damage since they are most likely to clip or distort during high-level music passages.

Since the speaker fuse and fuse holder we recommend may not be available locally, you may purchase them directly from AR at nominal cost. A price list for the fuses and their holders is available from AR upon request with a self-addressed, stamped envelope.

REMOVING THE DRIVERS

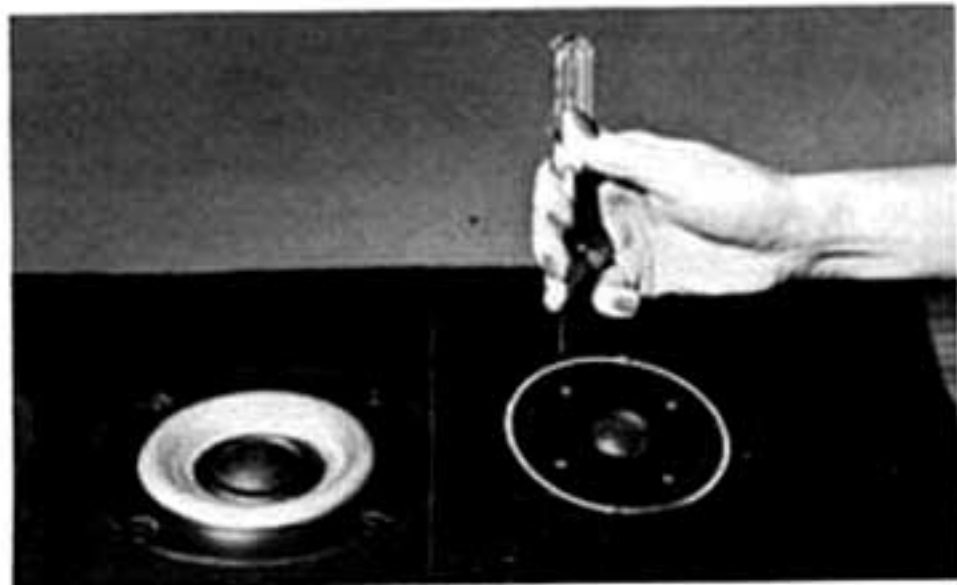
If at any time you experience difficulty you may find it more convenient, due to the size and weight of the AR-90, to return the driver which is the source of the problem, rather than pack and return the whole speaker to your dealer, local AR Independent Service Center or the AR factory. It should be easy to determine the source of any trouble by following the directions under "In Case of Difficulty". To remove any of

the drivers, please follow the instructions below. All the drivers, except for the upper-midrange, are secured to the enclosure with hex-socket-head machine screws. In order to remove the screws, you must use a hex, or Allen, wrench. These are available in most department and hardware stores. Most hex-wrench sets contain the necessary $\frac{1}{8}$ -inch hex wrench to remove the drivers' screws. To remove the $1\frac{1}{2}$ -inch hemispherical-dome upper-midrange driver all you require is a medium-to-large Phillips screwdriver.

NOTE: Before making any attempt at removing a driver, make certain to completely remove all the grille panels to avoid shearing off one or more of the grille-panel-mounting studs. Replacement of a sheared mounting stud is NOT covered by the Warranty.

TO REMOVE THE DRIVERS

1. If you are removing any of the upper-range drivers, place the enclosure on its rear panel, **after removing the three grille panels**. If you are placing the enclosure on a bare floor, protect the surface of the floor and rear panel of the enclosure from scratches by stretching towels or a throw rug on the floor prior to putting the cabinet down. If you are removing one of the woofers, swivel the enclosure onto the floor so that the woofer you are to remove will face upward. To prevent damage to the woofer on the opposite side, make certain you place a minimum of two telephone books, of approximately the same thickness, on the floor (one to support the middle and the other the top of the enclosure). The telephone books will keep the bottom woofer from having its outer suspension distorted and damaged by contact with the floor and the finished side of the enclosure from being scratched by a hard, unyielding surface. **In instances of woofer removal, it is probably best to enlist the aid of a second person. It will also be required, in instances of woofer and lower midrange removal, to first peel off the reticulated-foam gaskets, which cover the mounting screws, to facilitate access to the screw heads.**



2. Insert the correct hex wrench (or Phillips screwdriver) in each of its screw sockets and loosen and remove all the machine screws on the outer edge of the driver holding it onto the enclosure. **Do not loosen or remove the four small hex-socket-head screws which are in a square arrangement, inside the decorative silver ring, on the front of the highrange drivers. These are an integral part of the structure of the highrange and are used for the centering of the highrange's voice coil in the gap. Loosening or removing these screws will render the highrange inoperative and such damage is NOT covered by the Warranty.**

3. Once all the screws have been removed, insert an awl, nail, or small screwdriver into one of the screw holes in the driver chassis and lift it sufficiently to insert your fingers under the chassis, then raise it partially out of the enclosure. **Do not pull the driver out of the enclosure.** There are wires attached to it leading from the crossover.

4. Carefully note to which specific terminal of the driver the wires are attached. Polarity is very important. If you replace the driver you must reconnect the wires with the proper polarity in order to maintain the loudspeaker's performance and its flat frequency and power response. The polarity of all drivers is marked with a "+" or a red dot at or near the positive terminal.

5. Note which wire is connected to the positive

terminal, make a small label with Scotch or masking tape and attach it to the wire. **Do not trust your memory in this instance.** It is very easy to become confused with a device the complexity of which is unfamiliar to you. For your convenience and referral, the correct color-coded connections of the crossover to each driver in the AR-90 are listed in the chart at the end of this section.

6. The drivers are attached to the crossover via quick-connect, push-on terminals. Slide these off the driver terminal tabs being careful not to pull on the wires themselves as they will separate from the terminal making it then necessary to solder the wire onto the terminal stud.

7. Lift the driver out and away from the enclosure.

NOTE: You may note an absence of wadding directly behind the woofers. In the AR-90 all the wadding is located in the upper part of the enclosure where it is tightly packed to prevent resonances and standing waves within the enclosure. Since the woofers operate below 200 Hz, a region where wavelengths far exceed 5 feet, no absorption is required directly behind the woofers.

8. Replace the machine screws in the threads in the enclosure and finger tighten to prevent their loss.

NOTE: The special sealing gaskets on each driver are **NOT** reusable. If you loosen and remove a driver from the enclosure, the gasket must be replaced with a new gasket to maintain the seal of the enclosure. All AR replacement drivers are shipped with new gaskets. To ignore this recommendation in the case of some drivers may result in a loss in bass performance or "bottoming" of the woofers and damage **NOT** covered by the Warranty.

Special shipping cartons for all drivers are available upon written request to the AR Customer Service Department. It is recommended that these cartons be used whenever shipping a driver, to prevent damage. A driver damaged in shipping cannot be properly evaluated as to failure. In addition, damage to drivers in shipping which are improperly packed will not be recognized as an insurance claim by the carrier, and shipping damage is **NOT** covered by the Warranty. As a result, you may incur expenses for the repair of freight damages which are not reimbursable. It should be stated here that Acoustic Research cannot ship a replacement driver unless the defective one is received by AR prior to shipment. If you prefer, any defective driver may be taken to your nearest AR Independent Service Center and an exchange, over the counter, will be made at no charge to you so long as the unit is determined to be defective and is covered by the Warranty.

TO REPLACE THE DRIVERS

1. Remove the machine screws from the enclosure.

2. Make certain the replacement gasket is centered in the enclosure cutout and that the clearance holes for the mounting screws in the cabinet and gasket are directly over each other.

3. Push the quick-connect terminals on the wire onto the terminal tabs of the replacement driver making sure that the wire terminal is all the way onto the driver tab. Make certain to observe the polarity you have previously marked on the wires. If you are in doubt, check the correct color-coded connections of the crossover to each driver in the chart at the end of this section.



4. Be sure when replacing a woofer or the 8-inch lower-midrange driver that the connecting wires from the crossover are well out of way of the driver cone and tucked behind the magnetic structure at the back of the driver.
5. Center the mounting holes of the driver directly above the enclosure and gasket mounting holes. Start all the screws in their threads.
6. Insert the hex wrench in each of its screw sockets and tighten all the screws. The best way to begin is to tighten screws which are diametrically opposite, in a criss-cross fashion.
7. Check each screw with the wrench to make sure it is as tight as possible proceeding in a clockwise fashion around the driver, beginning with the top-most screw. Excessive torque is not required to insure a good seal. Simply use normal force on the wrench.
8. The woofers and 8-inch lower-midrange drivers are supplied with a self-adhesive, finishing trim made of reticulated foam. After the driver mounting screws are securely fastened, the cosmetic trim must be installed on the flange of the driver. Otherwise, the bright metal edge of the basket will be visible through the grille cloth. To install the gasket, first peel off the white backing from the back of the trim, which protects the adhesive, being careful not to stretch the foam. The foam trim is cut to match exactly the flange of its driver. Place the edge of the trim against the inside, edge of the driver's flange. Guide the trim around the periphery of the driver so that it will drop into the slot formed by the outer edge of the driver's diaphragm surround and the inner edge of the flange. Press down on the foam trim, all the way around the driver, to make sure the adhesive will secure the trim firmly to the basket.

NOTE: The crossover and/or portions of the crossover, such as switches, chokes, capacitors, etc., are not removable or field repairable. Refer any such service to your dealer, AR Independent Service Center or the AR Customer Service Department.



Driver	Crossover-Wiring Color Code
¾-inch highrange	"+" = yellow "-" = blue
1 ½-inch upper midrange	"+" = orange "-" = brown
8-inch lower midrange	"+" = white "-" = green
10-inch woofers	"+" = red "-" = black

MAINTAINING THE APPEARANCE OF YOUR SPEAKERS

The hand-rubbed, furniture-grade, oiled-walnut surfaces of your loudspeakers have been sealed at the factory through natural action of the finish applied. To protect their appearance, we suggest you apply two coats of a high-grade paste wax, such as Butcher's Wax or Staple's Paste Wax, following the directions on the can. By controlling the buffing of the wax, you can achieve the desired luster. For a dull finish, use a brush for both coats. For higher gloss, use a brush for the first coat and a flannel cloth for the second.

Alternatively, you may re-oil the enclosure by periodically rubbing in a boiled linseed-oil compound. This type of compound is generally available from department, furniture or hardware stores. Before applying oil make certain to remove the three grille panels to prevent staining of the cloth. Be sure also to

protect the surfaces under and around the speakers by covering them with a layer of newspapers. Apply a generous film of linseed oil, to the **walnut surfaces only**, with a lintless rag and permit the oil to soak into the wood for approximately 15 minutes. Remove the excess oil with another clean lintless rag and rub the cabinet surface in the direction of the grain until the desired luster is achieved.

It is recommended you make certain, when oiling the enclosure, that no oil is permitted to contact the decorative black-painted surfaces of the enclosure. With time, the oil may break down the paint's bond to the wood and flaking may be experienced. At the very least, you may encounter staining of the black-painted surfaces.

NOTE: Rags soaked with linseed oil and not handled properly are a fire hazard due to spontaneous combustion caused by heat generated as the oil oxidizes. Do not store such rags indoors. They should be spread on an outside window sill exposed to good ventilation and should not be discarded in a trash container unless thoroughly dry. **DO NOT THROW OUT IN A BALL UNLESS THE OIL HAS THOROUGHLY DRIED.**

The grille panels of your AR-90s are easy to care for. Simple, periodic vacuuming using an upholstery attachment or crevice tool is all that will be required. Be careful, however, when vacuuming not to snag the thin material and pull a thread. Although vacuuming can be performed while the grille panels are on the speaker, you will find it much more efficient and effective if you remove them from the loudspeaker enclosures. To remove the grille panels, grasp the two upper corners and gently, but firmly, pull outward. The grille panels will pivot on their lower edge and fall away from the lower grille-panel mounting sockets on the enclosures. To reinstall the grille panels refer to the section "**Installing and Removing the Grille Panels**".

It is doubtful, if the front grille panel is kept mounted on the enclosure, that the Acoustic Blanket™ will require cleaning. Should this become necessary, all that will be required is vacuuming with an upholstery attachment. Be careful not to bear down on the Blanket nor to permit the upholstery attachment to contact or pass over any of the drivers, since the vacuum and its consequent rush of air is sufficiently powerful to lift layers off the Blanket and cause damage to the drivers.

IN CASE OF DIFFICULTY

If your loudspeakers, when installed and adjusted in accordance with the instructions in this manual, do not operate correctly, please make the simple checks outlined below.

If your loudspeakers have worked properly since they were first installed but now seem to have developed a malfunction, please reread the instructions in this manual to make sure you are operating the system correctly in every way; then make the checks below. You may often save time, trouble and needless expense by taking a few moments to try and track down the trouble yourself. In most instances you will be able to locate the specific problem and rectify it easily.

WHAT TO DO

IN CASE OF FAILURE IN BOTH CHANNELS

It is almost impossible for both loudspeakers in a system to fail totally and simultaneously short of a catastrophic occurrence. In almost all cases at least part of the speaker, woofer, midranges or highrange, will operate. Therefore, failure in both channels will be found elsewhere.

1. Check the receiver or amplifier to make certain it is energized. If the dial or pilot light is off, make sure the AC line cord is plugged into a standard wall outlet. If it is, plug a lamp or other appliance into the wall outlet to make certain it is energized. If the AC outlet is energized, check the AC fuse or circuit breaker in the receiver or amplifier to be certain it is not blown. If you replace it and the fuse blows again, it may be an indication that there is an internal short in the amplifier. If the fuse blows only while playing loud music passages, it may indicate you are exceeding the output capability of the power amplifier.

- 2.** Make certain that the volume control in the amplifier or receiver is not in its maximum counterclockwise position. Sometimes separate "loudness" controls can decrease the apparent volume level substantially if at their maximum clockwise (or counterclockwise) position. Rotate the loudness control to make certain.
- 3.** Make sure the correct music source has been selected by the source switch on the amplifier or receiver.
- 4.** Make sure, if the amplifier or receiver has multiple speaker switches, that one has not been placed accidentally in a position which disconnects internally the speakers you are using.
- 5.** Check the tape monitor switch in the amplifier or receiver to make sure it is in the source or out position.
- 6.** Check the speaker cables to make certain no strands of wire are shorting out a speaker at either the speaker inputs or the amplifier outputs. Shorts of this type may cause the amplifier outputs' protective fuses to blow or internal safety circuits to be triggered interrupting operation. If you experience this type of short, tin the wires or install spade lugs to prevent a recurrence.
- 7.** Be certain there are no breaks in the cables. If the cables have been spliced at any time, check the splices to see that the wires are not touching each other at a point where they are not insulated and that the splice is still firm, with a good connection.
- 8.** If while experimenting with the speaker cables, operation is restored at any time, replace the cables with a new set and make sure to tin the wires or put spade lugs on the ends of the cables to prevent shorts.
- 9.** Check the speaker fuses or any other form of speaker protection on the amplifier, such as circuit breakers, to make certain they have not blown, or been triggered, due to a momentary short in the speaker cables or an overload caused by a demand for too high a volume level. Continual blowing of these fuses, or triggering of circuit breakers, may indicate a short circuit in the speaker cables, the loudspeaker input terminals, the amplifier output terminals or demands for volume level exceeding the capability of the power amplifier.
- 10.** Check any speaker fuses you may have installed, such as the Buss FNM type of fuse recommended, to make certain the connections are properly made and no wire strands are shorting to the other conductor. Short the fuse holder momentarily by bridging with a screwdriver, knife or similar tool the two spring contacts which hold the fuse and see if operation is restored. If operation is thus restored, the fuse is blown. A blown fuse may indicate too high a demand for volume level or a malfunctioning amplifier.

IN CASE OF DISTORTION OR BUZZ IN BOTH CHANNELS

It is extremely unlikely that both loudspeakers in a system will malfunction identically unless they have been abused and the precautions advanced in the previous instructions have been disregarded.

- 1.** If you experience distortion, buzz and rattle during loud passages that disappear when the volume level is reduced, it is usually indicative of an overloading amplifier. Please note that amplifier overload (clipping) is very commonly mistaken for a defective loudspeaker since an overloading amplifier can imitate speaker rattle and distortion to perfection. If the amplifier is not malfunctioning in some way, this occurrence may point to insufficient output power for your specific listening room and listening tastes. If you are using substantial bass boost through either the bass control, loudness control or both and thereby exceeding the output capabilities of the power amplifier, you will have to reduce these demands or replace the amplifier or receiver with one capable of delivering much greater power.
- 2.** If high distortion is present consistently but is specially audible during loud passages or music peaks, it may be a symptom of transient or incipient supersonic oscillation (ringing), or subsonic oscillation. This condition is an amplifier malfunction that should be remedied immediately if loudspeaker damage is to be avoided.
- 3.** If distortion with only one source (tuner, tape recorder, phono) and particularly during high-level peaks is present, it may be the result of the source having an output level sufficiently high to overload the inputs to the amplifier or receiver. In such cases, the output level controls of the source (if any) should be adjusted to the point where distortion is not evident. In those cases where the source has no level controls, consult its manufacturer concerning installation of an attenuator to effectively reduce the output level of the device.

IN CASE OF DISTORTION OR BUZZ IN BOTH CHANNELS WITH RECORDS ONLY

1. Inspect the stylus for dust accumulation and damage. If in doubt, have the stylus checked by your dealer under a microscope to be sure that it is not worn or damaged.
2. Double check the tracking force (see the Owner's Instruction Manuals supplied with your turntable and cartridge). Be certain the tracking force is set somewhere in the upper half of the recommended range. Insufficient tracking force will cause severe distortion on loud recorded passages.
3. Make sure the tonearm adjustments in your turntable have been properly made. If, for example, the counterweight of your tonearm (if one is provided) is incorrectly adjusted, it may substantially affect the adjustment of the tracking force.
4. If the distortion is present only on certain records, try to find out if the records themselves are faulty. It is unlikely that a defect in the speakers will be audible only on a few records.

IN CASE OF HUM OR RUMBLE

Loudspeakers do not hum or rumble. The cause of the problem will always be found elsewhere in the system.

1. Hum, rumble or rattle present only while playing records, which stops directly upon removal of the stylus from the record indicates either a faulty turntable or "acoustic feedback," a phenomenon present when bass energy from the loudspeakers is mechanically coupled back to the turntable and stylus. To determine if acoustic feedback is present, turn the volume control of the receiver or amplifier completely counterclockwise, place a record on the turntable with the motor mechanism turned off (in some instances with certain kinds of turntables the AC cord supplying power to the turntable may have to be disconnected from the AC outlet on the wall, or the amplifier or receiver AC convenience outlet) and put the stylus in the lead-in grooves of the record. Increase the volume control setting to a position roughly equal to or slightly higher than that required for your normal listening levels and lightly tap the chassis or base of the turntable. If hum, lengthy "boom" or rumble building in intensity become evident, immediately reduce the setting of the volume control to prevent self-sustaining acoustic feedback which may damage the loudspeakers, blow the amplifier or receiver loudspeaker outputs' protective fuse, or trigger its internal safety circuits. To lower the sensitivity of a system to acoustic feedback, the mechanical coupling between the turntable and loudspeakers must be reduced. If the speakers are near the turntable, move the turntable to another location. If relocating the turntable is not feasible, try placing a thick sheet of foam rubber or other resilient material between it and the surface on which it rests. If the speakers are in another part of the room, you may have to move them to a firmer spot on the floor. You may also reduce the setting of the bass control or make use of the rumble or low-frequency filter, if one is provided on your amplifier or receiver, to reduce the low-frequency output from the speakers and decrease acoustic feedback. It bears noting that the wider the range of an audio system the more susceptible it is to this type of phenomenon. If the hum or rumble is not due to acoustic feedback, check to make sure that all the "transit" or shipping bolts on your turntable have been released (refer to your turntable's Owner's Instruction Manual), otherwise the suspension of the turntable may not be effective and motor vibration is probably being coupled to the record and stylus. Make sure also that nothing (wires or other objects) under the turntable is pushing against the motor housing reducing the effect of the motor isolation mounts.
2. Reverse the AC plug of the amplifier or receiver in the wall socket to see if hum is reduced. Reverse also, one at a time, the AC plugs of the turntable and any other accessory devices which you may have connected to your system and leave the AC plugs in the position resulting in lowest hum. It is possible, for example, to have high hum level in the phono position of the selector switch if another device connected to the amplifier or receiver has its AC plug improperly phased with respect to the other AC plugs.
3. Hum in the phono position of the selector switch which varies with the position of the tonearm and cartridge generally indicates the presence of a hum field from the transformer of an auxiliary source such as a tape or cassette recorder or the amplifier or receiver itself. Move the turntable away from electronic accessories near it. If the hum decreases, you will have to place the turntable further away from the auxiliary

source until hum is minimal. In some cases, changing the relative positions of the turntable and the source of hum will suffice.

4. If any auxiliary source such as a tape recorder is connected to the amplifier or receiver, reverse its AC plug in the wall socket. Some AC-DC-battery tape recorders may generate hum when connected to the amplifier or receiver while its AC converter or battery charger is being used. If reversing the AC linecord of the battery charger does not decrease the hum, check with the dealer from whom you bought the recorder concerning the use of an AC isolation transformer or other means of hum reduction.

5. If hum is apparent only during use of a tape recorder or other auxiliary source, make sure the correct audio cables were used for interconnection and that the plugs are tight and properly seated in their jacks. Persistent hum even with the correct cables and AC plug orientation may indicate a faulty recorder or source or, in some cases, excessively long interconnecting cables. It is also possible for hum to be induced into the playback head of a tape or cassette recorder by the transformer of a nearby auxiliary source or the amplifier or receiver itself. If the hum decreases as you move the recorder away from electronic accessories near it, ultimately you may have to select a different placement of the recorder to avoid hum induction.

IN CASE OF FAILURE, INTERMITTENCE OR DISTORTION IN ONE CHANNEL ONLY

1. Check the connections at the red and black five-way binding posts on the loudspeaker input plate recessed into the rear panel of the loudspeaker enclosure to determine that the wire has not been accidentally pulled off the connectors and that wire strands are not shorting out the speaker input terminals. Tin the wires or install banana plugs or spade lugs to prevent this occurrence.
2. Check the appropriate loudspeaker-output terminals on the amplifier or receiver to make sure proper connections have been made and the wires are not loose, broken or shorting out at the terminals. Again, tin the wires or install spade lugs to prevent problems.
3. Bend and twist the speaker cables at any point where they are led over a sharp corner or edge to determine if the wire is broken.
4. Interchange the cable connections at the amplifier or receiver (connecting the left-speaker cable to the right-loudspeaker output terminals and vice-versa). If the trouble remains in the same speaker regardless of the channel to which it is connected, the speaker is at fault. If the trouble shifts from one speaker to the other as you reverse cable connections, the fault may lie in the amplifier or receiver. Check the possibility of a faulty speaker cable by trying each cable from each set of loudspeaker-output terminals on the amplifier or receiver to each speaker.
5. Try different sources (phono, FM, AM, etc.) to determine if the trouble is in only one source and not all sources.
6. If you are using the tape out jacks of the amplifier or receiver with a tape recorder, unplug the cables from the amplifier or receiver to determine if a short is present in either the cables or recorder.
7. If the problem is traced to one source only and this source is separate from the amplifier or receiver (as would be the case with the turntable or a tape recorder), check the points at which the interconnecting audio cables enter the plastic strain relief on the plugs by gently bending and twisting the cable. Any intermittent, broken or suspect cable should be replaced at once to prevent future difficulties. If the problem persists even though the cables appear intact and connections well made, exchange the cables on the channel with the problem with the cable on the properly operating channel, to determine if the cable is at fault, rather than the source.
8. If harshness or distortion is experienced, exchange the amplifier leads (connecting the left-speaker cable to the right-loudspeaker output terminals on the amplifier or receiver and vice-versa). It is not sufficient to operate the channel reverse switch on the amplifier or receiver since the output stages of the power amplifier are **NOT** reversed by this switch and will continue to drive their respective speakers. The cables **must** be interchanged. If when the cables are interchanged the distortion remains on the same speaker, the speaker is at fault. If the trouble shifts from one speaker to the other, the fault may be in the amplifier or receiver.

9. If the distortion or buzz is traced to the loudspeaker, the probability is that the speaker is defective. However, be certain to check loose objects, shelves and pictures on walls in the vicinity of the loudspeaker. Very often these articles will buzz when triggered by sound from the speaker, particularly at loud volume levels, and can create the impression of a defective loudspeaker.
10. Follow the directions, also, in steps 9 and 10 under the previous sub-section "**In Case of Failure in Both Channels**".

IN ORDER TO DETERMINE WHICH DRIVER IS DEFECTIVE

1. Place the amplifier or receiver volume control at a setting lower than normal, the mode switch on mono and tune to a point on your tuner dial between stations with the "mute" control on the tuner off so that the interstation noise is audible.
2. Rotate the balance control on the amplifier or receiver so that only the defective loudspeaker is operating.
3. Remove the front grille panel by grasping the two upper corners and gently, but firmly, pulling outward. The grille panel will pivot on its lower edge and fall away from the lower grille-panel mounting sockets on the enclosure.
4. Place your ear close to each driver to determine if one is not operating. If you locate the defective driver, remove it following the instructions in the section "**Removing the Drivers**".
5. If you are experiencing distortion, select the music on which the distortion is most evident, with the volume control at its normal position, the mode switch on mono and the balance control positioned so that only the defective loudspeaker is operating.
6. Determine whether the distortion is being caused by the woofers, lower-midrange, upper-midrange or highrange. Turn the volume control down and the power off.
7. Disconnect the suspected driver following the instructions in the section "**Removing the Drivers**". If a driver (other than the woofers) is disconnected, it must be remounted in its cutout to insure a good enclosure seal. Otherwise, the woofers will have insufficient "stiffness" or "loading" and may "bottom" during the tests following causing woofer damage **NOT** covered by the Warranty. Make sure also that the gasket is properly installed and that all the driver screws are securely fastened. **When replacing the driver in the enclosure cutout, with its crossover wires still disconnected, make certain the quick-connect terminals on the ends of the crossover wires are widely separated, or insulated, to prevent shorting.**
8. Turn the power on and the volume control up to its normal position and see if the distortion has disappeared. It is difficult to readily identify a distorting driver if the distortion occurs in or near the crossover region.
9. If the distortion is still present, reverse the driver disconnection and connection procedure. That is, if the highrange is disconnected first and the distortion is still present, reconnect the highrange and disconnect the upper midrange to determine exactly which driver is causing the distortion. The same procedure may be followed with the other drivers in the system. For example, if the lower midrange is disconnected first and the distortion is still present, reconnect the lower midrange and disconnect **both** woofers.
10. To replace any of the grille panels you have removed, refer to the section, "**Installing and Removing the Grille Panels**".

SERVICING

If you are unable to find the reason why your loudspeaker(s) is not operating properly by reading through this manual and following the procedures listed under the section "In Case of Difficulty", please follow the instructions outlined below.

Whenever possible, please contact the dealer from whom the system was purchased to arrange for verification of the defect, any services you require, or replacement of any defective drivers in the system. If your dealer is not within the immediate area or cannot inspect your unit for any reason, write directly to the Customer Service Department, Teledyne Acoustic Research, 10 American Drive, Norwood, MA 02062, describing the trouble and any tests you have made, with as much detail as possible, giving the name of your dealer, date of purchase and the serial number of your loudspeaker(s). You will find the serial number of your speakers, on a tab, on the logo plate attached to the front panel of the enclosure, directly below the three upper-range drivers. Alternatively, you may take any defective drivers directly to the regional AR Independent Service Center. A list of AR Independent Service Centers was packed with your loudspeakers and is available upon request from the AR Customer Service Department. AR will make every effort to remedy any problem you may be experiencing at minimum inconvenience to you.

Do not ship your loudspeaker or any of its drivers to the Acoustic Research factory without requesting and receiving a Repair Order Form with Special Shipping Label prior to shipment.

Freight charges must be **prepaid** when a loudspeaker or any of its drivers are shipped to AR for repairs. If the repairs are covered by the Warranty, all **surface** freight expenses will be reimbursed upon completion of the repair and submission of both the green Freight Refund copy of the Repair Order Form and original freight bill.

NOTE: Due to the size and weight of the AR-90, the possibility of damage in shipping is higher than with smaller loudspeakers. It is therefore suggested that, if it is at all possible, you return any defective drivers rather than the whole speaker, thereby avoiding inconveniences and delays which you may suffer if you return the loudspeaker itself. Shipping cartons for all AR drivers are available by making a written request to the AR Customer Service Department.

It is the responsibility of the sender to see that a loudspeaker, or any of its parts returned for service, are properly packed. Damage to loudspeakers or drivers in shipment due to incorrect packing will not be recognized by the carrier as an insurance claim, and the sender will be charged for any parts and labor required to return the unit to proper operating condition. To insure freedom from damage in shipment, the speaker must be packed as it was when it left the AR factory. If you no longer have the original factory carton and packing materials, you may obtain a replacement by making a written request to the AR Customer Service Department.

DO NOT SHIP LOUDSPEAKERS, OR ANY DRIVERS, WITHOUT FIRST OBTAINING THE CORRECT FACTORY PACKING OR THEY ARE CERTAIN TO BE DAMAGED IN SHIPPING. WE SHALL NOT ASSUME ANY RESPONSIBILITIES IF THIS PRECAUTION IS IGNORED.

SPECIFICATIONS: AR-90

Drive Units:

Two 250-mm (10-inch) acoustic-suspension woofers
200-mm (8-inch) high-temperature, acoustic-suspension lower midrange
38-mm (1½-inch) high-temperature, hemispherical-dome upper midrange
19-mm (¾-inch) high-temperature, hemispherical-dome highrange

Crossover Frequencies:

200 Hz, 1200 Hz, 7000 Hz

Electrical Crossover Slopes:

12 dB/octave on woofers at 200 Hz
6 dB/octave on lower midrange at 200 Hz
12 dB/octave on lower midrange at 1200 Hz
12 dB/octave on upper midrange at 1200 Hz and 7000 Hz
18 dB/octave on highrange at 7000 Hz

Impedance:

4 ohms nominal (3.2 ohms minimum)

Controls:

Three 3-position switches for lower-midrange, upper-midrange and highrange level control.

Efficiency:

1 watt will produce 87 dB SPL on axis at one meter.

Amplifier Power Requirements:

50 watts minimum, per channel, is recommended. 50 watts (into one speaker only) will produce 104 dB SPL in a 3000 cu. ft. room of average reflectivity (energy absorption coefficient of 0.15). 100 watts (50 watts into each channel) will produce 107 dB in the same room.

Power-Handling Capability:

May be used with amplifiers capable of delivering 300 watts continuous power per channel being driven to clipping not more than 10 percent of the time on normal music source material. This statement of power handling capability is based on the use of contemporary amplifiers of good design, stable operation and instantaneous recovery from overload and which are able to deliver very-short-duration peaks of approximately 2.5 times their rated continuous power into the normal, reactive, 4-ohm load of a loudspeaker. Under these conditions, instantaneous peaks of approximately 118 dB in a 3000 cu. ft. room of average reflectivity (energy absorption coefficient of 0.15) may be achieved. It should be noted here that severe clipping (exceeding 10 percent of the time) of any amplifier, of large or small output power capability, greatly increases the thermal stress placed on the loudspeakers and should be avoided under any conditions.

The data given above is predicated on the playback of music material having a peak-to-average ratio between 10 and 15 dB ("live" music waveforms generally have a peak-to-average ratio of 15 dB), so that when peaks of, say, 400 watts are fed to the speaker the average level of the signal will not exceed 40 watts long-term average. These statements of power-handling capability, particularly peak-power-handling capability, are not meant to describe operation during playback of highly compressed rock recordings in which the peak-to-average ratio rarely exceeds 5 dB. In these instances, when peaks of 400 watts are being fed to the speaker, the average level of the waveform will frequently exceed 120 watts—a level of such magnitude that the drivers will be unable to dissipate the heat generated in the voice coils for any length of time and consequent thermal damage to the drivers will result. This type of damage is NOT covered by the Warranty.

Crossover Networks:

Half-section LC networks on woofers and on lower- and upper-midrange units. Network of upper-midrange unit also includes an impedance-equalizing circuit. Full-section network on highrange. All the capacitors are computer-grade, bi-polar electrolytics. All chokes are air-core, wound with number 17 AWG solid conductor. The acoustic outputs of the lower-midrange, upper-midrange and highrange drivers are controlled by switchable non-inductive resistive networks.

Enclosure Finish: The AR-90 has an oiled-walnut-veneer finish.

Driver Resonance Frequencies:

Woofers 26 Hz (free air), lower midrange 175 Hz (in its enclosure), upper midrange 800 Hz, highrange 2000 Hz.

System Low-Frequency Response:

-3 dB at 32 Hz

Effective System Q:

0.8 at resonance

Flux Densities:

Woofers 7,800 gauss (each), lower midrange 7,800 gauss, upper midrange 13,000 gauss, highrange 14,000 gauss.

Volume of Enclosure:

90 liters (3.18 cu ft)

Enclosure Dimensions:

1102 X 368 X 386 mm deep (43¾ X 14½ X 15¼ inches) including grille panels

Weight:

Packed in carton 46 kg (101 lb)

Unpacked 37 kg (82 lb)

DIN SPECIFICATIONS

The German DIN standards are generally accepted in Europe as a means of comparing high fidelity equipment and are presented here for that reason.

Frequency Range: The limits of frequency range are those frequencies at which response is 8 dB lower than the average level, this average level being taken over the range 100 Hz to 4000 Hz.

Impedance: The nominal impedance of the system.

Sensitivity: The number of watts necessary to produce a sound pressure level of 96 dB at the measuring microphone, the watts being calculated from $Watts = V^2/R$, where V is applied voltage and R is numerically equal to the stated impedance.

Nominal Power Handling: The number of watts of a specially tailored noise spectrum that the system can withstand for one minute in every three over a total time of 300 hours, the power being based on the nominal impedance.

Maximum Power Handling: The maximum burst of power of no more than 2 seconds duration that the system can withstand at frequencies between 250 Hz and its low-frequency limit without audible distortion caused by such factors as limitations of coil or cone movement.

All frequency range, and sensitivity measurements were made in a 2π anechoic environment at a distance of one meter on the axis of the loudspeaker.

Frequency Range:	23 Hz-30 kHz
Impedance:	4 ohms
Sensitivity:	8 watts
Nominal Power Handling:	150 watts
Maximum Power Handling:	250 watts

Since it is the policy of Acoustic Research to continuously incorporate all engineering improvements into the products it manufactures, all specifications listed in this manual and other pertinent brochures are subject to change without notice.



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