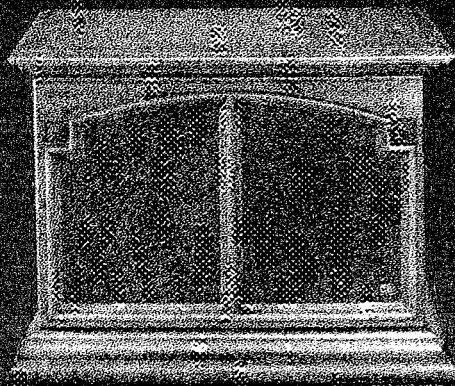


Owner's Manual

L71

Verona

JBL



Excellence is an elusive quality. It is so easy to recognize and so difficult to attain.

JBL craftsmen have been involved in the art of sound for more than a generation—signal and source, wood and fabric, transducers and acoustics—all of it.

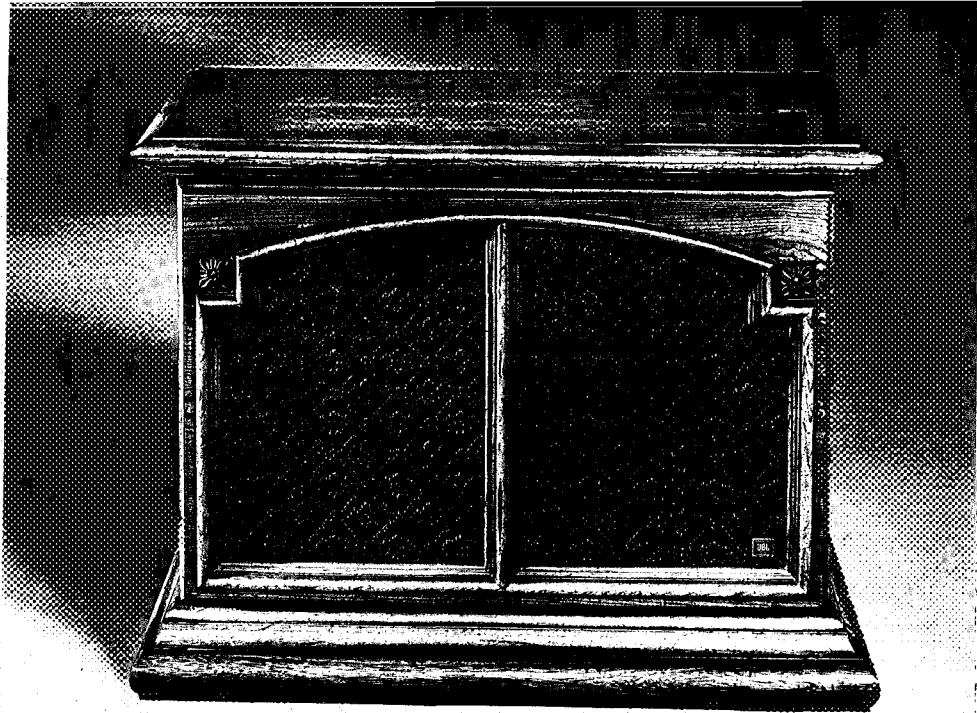
Today these craftsmen continue to perform to the most rigid standards any craftsmen can submit to: those they impose upon themselves.

JBL loudspeakers are carefully engineered instruments, painstakingly crafted and assembled to watchmakers' standards. JBL enclosures express the excitement of creative design; they are elegant, solid and flawlessly finished. JBL transducers and electronics offer what has been characterized by devoted music listeners as the "incomparable JBL sound."

By following the few simple suggestions contained in this booklet, you can look forward to superb high fidelity reproduction that will retain its clarity and realism year after year.

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JBL



The L71 Verona

An exciting addition to the JBL collection of superior high fidelity loudspeaker systems, the Verona delivers accurate sound reproduction that is warm and rich, exhibiting the natural, full-bodied characteristics of a live performance.

The Verona expresses all the traditional JBL values—superlative quality, performance, reliability, and distinguished furniture design—integrated into a loudspeaker system of exceptional beauty and acoustic excellence.

Derived from the historical forms of Northern Italy and Spain, the Verona expresses the timeless beauty of the Mediterranean. Curved moldings, carved rosettes and finely proportioned cap and base details, set off by a handsome brocaded grille fabric, evoke the visual richness of the Late Renaissance. The wide acceptance of the Mediterranean mood in today's home decor is based not only on its intrinsic appeal, but also on the ease with which it may be combined with contrasting furniture styles.

Performance Characteristics

Whether played at volume levels appropriate to background listening or the concert hall, performance of the Verona is characterized by bass that is solid, realistic and well-defined, never boomy or unnaturally accentuated. Midrange reproduction, the very heart of the audio spectrum, is smooth and accurate. High frequency material is delineated with utter clarity and transparency, without being strident. The balanced performance of the Verona will provide hours of continuous musical enjoyment, devoid of aural fatigue.

The loudspeaker system installed in the Verona will complement even the largest listening rooms, providing smooth performance regardless of listening level. The 15-inch low frequency loudspeaker, 5-inch midrange transducer and 1.4-inch high frequency direct radiator are controlled by a dividing network matched to the electrical and acoustic characteristics of each component loudspeaker in the system. Presence and Brilliance controls are located behind the easily-removed grille to allow

adjustment of the system to accommodate room acoustics and personal preference.

To accurately test the loudspeaker system, a set of evaluation parameters was developed, and specifications derived from measurements made under standard laboratory test conditions. The L71 was mounted in the measured center of a large flat baffle in a reverberation-free environment. A calibrated condenser microphone was suspended at a specified distance from the sound source. All electronic equipment was checked and calibrated before tests were run.

Due to the wide-angle sound dispersion characteristic of the loudspeaker system components of the L71, frequency response measured up to 45° off-axis does not deviate more than 6 dB from on-axis response.

A number of loudspeaker systems can handle large amounts of power; others are highly efficient. JBL products are unique in their ability to combine both attributes. The L71, for example, will convert a 1 Watt input of "white noise"¹ into a sound pressure level of 80 dB measured at a distance of 15 feet.² This is approximately twice as loud

as ordinary conversation and represents a comfortable listening level, demonstrating that the L71 delivers substantial output from very little input power.

1. "White noise" is a rigorous test simulating average musical program material under laboratory conditions. It provides a controlled means of energizing all the transducers of a loudspeaker system simultaneously. "White noise" encompasses all audible frequencies just as white light includes all the colors of the visible spectrum. Produced in the laboratory by a signal generator, "white noise" sounds very much like the hiss heard between FM radio stations.

2. A decibel (dB), in this context, is a unit expressing relative loudness of sound. Three dB is approximately equal to the smallest change in loudness of program material ordinarily detectable by the human ear.

Specifications

JBL attributes major importance to the validity of published information. Rather than repeat the ambiguity of most technical specifications, JBL has traditionally refrained from listing data for which no widely-accepted test procedure has been established. In the absence of such standards, any well-equipped laboratory can legitimately produce a variety of frequency response curves for a loudspeaker, depending on the conditions selected. At JBL the final analyses are comprised of extensive listening sessions. Although laboratory data are an integral part of the process, the trained ear is the ultimate criterion. The success of this philosophy is reflected in the enthusiastic acceptance of JBL systems by recording studio engineers, producers and performers—professionals whose artistic achievements are closely related to the equipment they use. In every critical listening situation—wherever the sound of the loudspeaker must be depended upon—JBL is the overwhelming professional choice.

Power Capacity*	75 Watts continuous program
Nominal Impedance	8 ohms
Dispersion	90° horizontal and vertical
Crossover Frequencies	1200 and 7500 Hz
Efficiency	1 Watt input produces 80 dB Sound Pressure Level at a distance of 15'. (Note: 75-80 dB is a comfortable listening level.)
Finish	Pecan, distressed and hand-shaded
Grille	Brocaded Fabric
Dimensions	27½" x 36½" x 17¼" deep 70 x 93 x 44 cm deep
Shipping Wt.	131 lbs 59 kg

**Based on a laboratory test signal.
See Power Capacity section for amplifier power recommendation.*

Low Frequency Loudspeaker

Nominal Diameter	15 inches
Voice Coil	4 inch, edgewound copper ribbon
Magnetic Assembly Wt.	11 pounds
Flux Density	12,000 gauss
Total Flux	275,000 Maxwells
Bl Factor**	4.3 pounds per ampere
Sensitivity***	44 dB

Midrange Transducer

Nominal Diameter	5 inches
Voice Coil	7/8 inch, edgewound copper ribbon

** Bl Factor is a measurement of the loudspeaker's ability to convert electrical energy to mechanical force.

Magnetic Assembly Wt.	2.75 pounds
Flux Density	16,500 gauss
Total Flux	24,000 Maxwells
Bl Factor	0.76 pounds per ampere
EIA Sensitivity	46 dB

High Frequency Direct Radiator

Nominal Diameter	1.4 inches
Voice Coil	5/8 inch, copper
Magnetic Assembly Wt.	1.5 pounds
Flux Density	15,000 gauss
EIA Sensitivity	47 dB

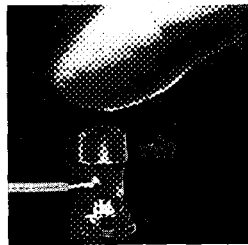
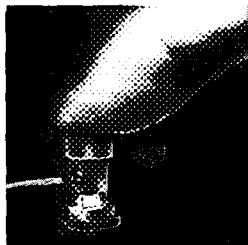
*** Since the major portion of the energy reproduced by the low frequency loudspeaker lies below 800 Hz, this specification has been developed by using a test signal warbled from 100-500 Hz, rather than the conventional 1 kHz sine wave test signal on which the EIA sensitivity rating is based.

Connecting the Verona

IMPORTANT: When connecting or disconnecting loudspeakers from an amplifier, the amplifier must be turned off. Making connections while the amplifier is operating could seriously damage the loudspeaker system and void the warranty.

Eighteen-gauge insulated wire (ordinary household lampcord) is the minimum size recommended for loudspeaker connections up to 50 feet. Beyond this distance, heavier gauge insulated wire is recommended; 16-gauge from 50 to 100 feet and 14-gauge from 100 to 200 feet. If lampcord is used, wires can be differentiated by noting that one of the insulating jackets is smooth, while the other has a distinct ridge. By considering the ridged jacket "red" and the smooth jacket "black," wiring connections can be made as if using color-coded wire.

Connections to the audio power source are made using the two pushbutton terminal posts located on the back of the loudspeaker system enclosure. The holes in JBL terminal posts do not allow the connecting wire to pass all the way through, preventing the possibility of a short to the other terminal post or to nearby electrical conductors.



- 1. Depress colored button, exposing hole in terminal post.*
- 2. Push stripped end of lead wire into hole and release button. Never apply twisting force to the terminal post.*

To make a secure connection, strip approximately $\frac{1}{4}$ inch of the insulation from the end of the wire, push down the spring-loaded terminal post cap, insert the bare wire into the exposed opening of the terminal post and release. (Insertion of the wire into the opening will be easier if the stripped wire is first tinned with a soldering tool and solder).

Locate the loudspeaker output terminals on the back of the receiver or power amplifier. For

each loudspeaker system, connect the wire from the black terminal post to the amplifier output terminal labeled "common," "ground" or (-), and the wire from the red terminal post to the remaining 8-ohm speaker output.³

Note that many amplifiers have a chassis grounding terminal which is usually isolated from the other connectors. This should not be confused with the "ground" designation sometimes used to describe two of the terminals in each set of loudspeaker connections.

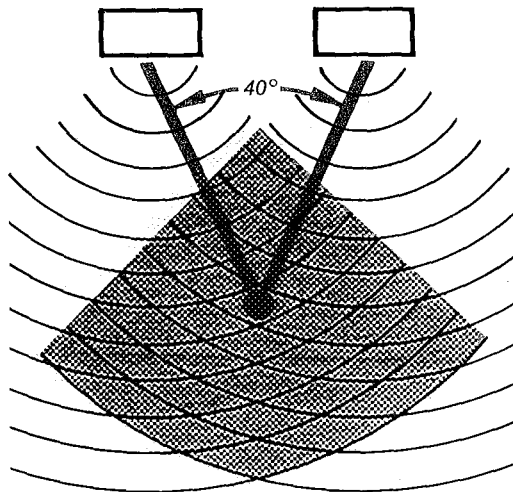
The specified 8-ohm impedance rating is a nominal figure which suggests a connection giving the most efficient power transfer between amplifier and loudspeaker system. However, 4- or 16-ohm amplifier terminals can be used without danger.

3. Connecting both speakers as described will insure proper "in phase" operation; i.e., their cones will respond to a monophonic signal by moving simultaneously in the same direction, and not opposite to each other. Inadvertent out-of-phase operation (which occurs when one set of speaker wires is reversed with respect to the other) will not harm the system, but may cause some acoustical "cancellation" which will have the audible effect of reducing low frequency response.

Placement

Although JBL loudspeakers have a wide sound dispersion pattern, the final sound of the completed installation is affected by the location of the enclosure within the listening environment. If possible, experiment with placement of each loudspeaker system before deciding on a final arrangement.

For the best possible stereo performance, the two loudspeaker systems should be arranged symmetrically on each side of the listener. As a general rule, a person sitting in the usual listening position should see an angle of about 40° between the two sound sources. The distance from one loudspeaker enclosure to the other is determined by their distance from the listener and by the 40° "listening angle." Bass response will be augmented if the enclosures are placed near adjacent room surfaces, such as in a corner.



40° "Listening Angle"

Sound energy from each loudspeaker blends to form a stereo "wall of sound." The stereo image will be intensified and the area of best stereo perception increased if the two systems are rotated slightly toward the preferred listening position.

Listening Room Acoustics

The sound reflecting or sound absorbing qualities of the listening room will affect the sound quality of a loudspeaker system. Room acoustics can be tested by listening to the echo of a sharp sound, such as hand clapping.

A room having large windows, paneled walls and a hardwood floor or ceiling will be acoustically "live" and will echo noticeably. A room containing overstuffed furniture, carpeted floors or draped windows will be acoustically "dead" and will echo very little or not at all.

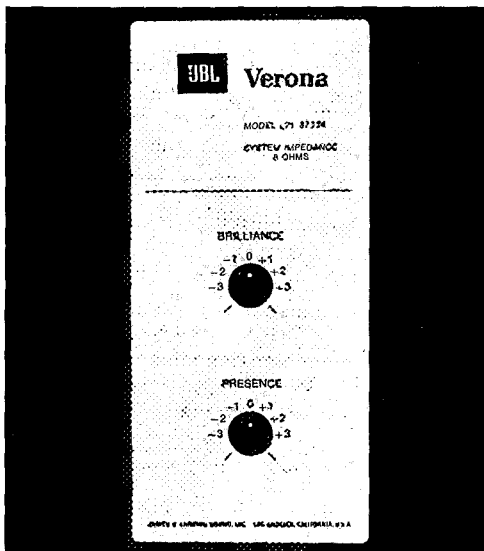
Ideally, there should be a reasonable balance between absorptive material and sound reflecting surfaces. If there are two large reflecting surfaces facing each other, the "bounce" between them will make sounds run together and the music will lack definition. Large, flat wall surfaces should be broken up with bookshelves, drapes, screens or tapestries.

Adjusting the System

The Verona is provided with a Presence control to regulate the relative loudness of the midrange transducer and a Brilliance control to adjust the volume or level of the high frequency direct radiator. These controls adjust the output of the component loudspeakers to achieve realistic tonal balance in a variety of room conditions.

The controls are calibrated in terms of a reference level, indicated by a "0" on the instruction plate. When both the Presence and Brilliance controls are set at this level, the loudspeaker system will be adjusted for balanced performance characteristics in a reverberation-free environment. Since most listening rooms possess varying degrees of reverberation, some adjustment of the controls is usually preferred.

The loudspeaker system should be adjusted while reproducing normal program material with the amplifier tone controls set at the middle (generally referred to as "flat") position. Begin by placing both of the loudspeaker system controls at the reference level and listening to a variety of



Presence and Brilliance controls are located on the front of the enclosure, behind the removable grille assembly.

program material long enough to become accustomed to the system's performance.

After the ear has become attuned to the "0" setting, evaluate the presence and brilliance qualities of the loudspeaker's performance. The most valid evaluation will be obtained using a variety of program material played monaurally. (This can be accomplished in stereo or quadraphonic installations by setting the amplifier mode control for monaural reproduction and using the balance control to select the individual loudspeaker system to be adjusted.) The evaluation should be made while seated in the normal listening position.

To arrive at the specific setting for each of the loudspeaker system controls, proceed as follows:

1. Set the Presence control at "0" and rotate the Brilliance control to the extreme left of its travel. This will attenuate high frequency performance so that the ear will perceive only the balance between the low frequency loudspeaker and the midrange transducer.
2. If midrange material—such as violins, piano or guitar—seems too close or overemphasized, reduce the setting of the Presence control by rotating it to the left. Conversely, if midrange material seems too distant, increase the output of the midrange transducer by rotating the control clockwise.
3. Once the Presence control has been adjusted to provide the most pleasing balance between the low frequency and midrange transducers, set the Brilliance control at "0". If high frequency material—such as cymbals, bells, triangles, violin overtones or vocal sibilants—seems too prominent, lower the setting of the Brilliance control. If greater high frequency output is desired, increase the setting of the control.

After each set of adjustments, again listen to a variety of program material until the ear has become attuned to the new characteristics and can compare them to the previous performance of the system. Once the Presence and Brilliance controls have been set for the most pleasing overall results, and the exact placement of each loudspeaker has been determined, compensation for differences in individual recordings should be made with the tone controls on the amplifier or receiver.

Power Capacity

The Verona will reproduce clean sound at comfortable listening levels when driven by an amplifier having an output of as little as 10 Watts RMS per channel.⁴ However, for reproduction of the full dynamic range of contemporary recordings at high volume, a quality amplifier delivering from 60 to 150 Watts RMS per channel will provide optimum performance. Such an amplifier has the reserve power necessary for accurate reproduction of transients which can reach momentary peaks equivalent to ten times the rated power handling capacity of the loudspeaker system.

In almost all cases, the volume level generated by a JBL loudspeaker system will become noticeably discomforting to the ear before it can be damaged by excessive power from the amplifier. There is virtually no danger of damaging a JBL loudspeaker if it is operated within the following guidelines:

1) the signal from the amplifier, regardless of its rated power, is not distorted; 2) the amplifier is not driven into clipping (another form of distortion which occurs when the power output limitations of the amplifier circuitry are exceeded); and 3) the

power cord or audio connectors are not inserted or unplugged while the amplifier is operating.

However, a powerful wide range amplifier can accidentally damage any loudspeaker under certain conditions. For example, rewinding a tape recorder with the playback volume turned up can generate "squeals" powerful enough to burn out the midrange and high frequency units. Similarly, powerful low frequency pulses extending down into the subsonic range can eventually damage the low frequency loudspeaker. If the phonograph pickup is accidentally dropped with the volume control full up, or if the system is played very loudly with excessive bass boost, nearly the full rated power of the amplifier can be channeled into dangerous subsonic energy.

4. The RMS (root mean square) rating of amplifier power is the most stringent method currently used in the audio industry. An amplifier rated at 60 Watts RMS per channel, for example, is generally considered to be a high-powered unit. The same output expressed in terms of "Music Power" (IHF) would be 160 Watts.

System Components

The components used in every JBL product are designed and produced by JBL personnel to rigorous standards. JBL loudspeaker frames are massive rigid structures, produced to exacting tolerances. Magnetic assemblies are precisely manufactured of low-reluctance iron, energized by large, high grade magnets. Voice coils are held to within one turn of design specifications. Stamped frames, punched magnetic structures and mass-produced voice coils would be less expensive; however, the resultant loss of structural integrity, magnetic force and acoustic efficiency would tend to degrade low-distortion performance and transient response—qualities that have become JBL hallmarks.

Do not move the cone by hand. The clearance between the voice coil and magnet assembly is so small that any attempt to move the cone manually can easily force it out of alignment.

Low Frequency—Effortless reproduction that is clean, crisp, inherently linear and distortion-free is achieved by a 15-inch low frequency loudspeaker

having a 4-inch edgewound copper ribbon voice coil, large radiating area and 11-pound low-loss magnetic assembly. The voice coil is fabricated of wire milled to a flat ribbon, wound on the ribbon's edge by hand. Edgewinding compacts more conductor into the magnetic field contained in the voice coil gap than conventional round wire, increasing efficiency and improving transient response. The coil drives a freely suspended, damped cone. A highly flexible ring suspension, developed by JBL, extends bass response and allows extreme cone excursion with perfect linearity. The cone damping material, which gives it its white color, is an exclusive JBL formulation known as Lansaplas. The material is inert, self-damping and impervious to environmental changes. Lansaplas adds stiffness and mass to the cone for optimum accuracy of bass response and smooth performance through the vital midrange region of the audio spectrum. The low-loss magnetic assembly concentrates all of the essential magnetomotive energy, provided by the powerful Alnico V magnet, in the one place where it contributes most to loudspeaker performance—the voice coil gap.

Extreme linear excursion, large radiating area, optimum cone density and edgewinding of the voice coil are important engineering advances that enable this 15-inch transducer to reproduce clean, solid bass without audible distortion, even at very high power levels. Efficiency and dynamic range are further increased by the use of an enclosure having a ducted port, carefully tuned for optimum bass performance.

Midrange—The middle region of the audio spectrum, such as vocal overtones and strings, is reproduced by a 5-inch transducer possessing peak-free, uniform sound distribution, both on- and off-axis. Its $\frac{7}{8}$ -inch copper voice coil is immersed in an intense magnetic field provided by a 2.75-pound magnetic assembly energized by an Alnico V magnet. The molded cone is terminated with a viscous-damped suspension to absorb spurious resonance. The entire moving assembly is rigid, yet exceptionally light—a combination permitting outstanding transient reproduction.

Its extreme sensitivity and high power handling capacity allow greater undistorted acoustic output

than any other small cone loudspeaker. The unit is separately housed within the main enclosure to prevent acoustical interaction with the low frequency driver and to optimize its superior response characteristics.

High Frequency—Reproduction of program material above 7500 Hz is provided by a 1.4-inch direct radiator energized by a 1.6-pound magnetic assembly that concentrates an intense magnetic field in the voice coil gap. Its $\frac{5}{8}$ -inch copper voice coil is unusually large in relation to cone size, providing high efficiency and exceptional transient response. The precisely formed cone assembly is suspended with an impregnated cloth termination to insure linearity and absorb spurious resonance. The cone is surrounded by dense foam damping material to prevent unwanted radiation and reflections.

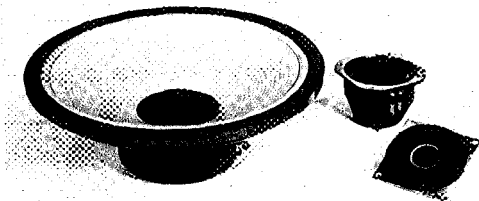
The small radiating surface of the cone is responsible for the wide high frequency dispersion of the device, assuring that each listener hears the same tonal balance and blend of direct and reverberant sound. The result is transparent, distortion-free reproduction of delicate treble

overtones and harmonics extending beyond the range of human audibility.

Dividing Network—Smooth, imperceptible transition between loudspeaker components is controlled by a frequency dividing network carefully engineered and tested to complement the specific electrical and acoustic characteristics of the system. The function of a precision dividing network is considerably more complex than merely feeding low frequencies and high frequencies to their respective transducers. Vitally important to the total sound of a JBL loudspeaker system is the way the network distributes electrical energy for optimum control of the system components through the transition frequencies.

JBL network component tolerances are much more stringent than normal industry practices. For example, JBL networks use non-inductive, non-polarized capacitors—not electrolytic types—individually tested to meet rigid production tolerances. The special inductors used in JBL networks have extremely low insertion loss so that none of the driving power to the loudspeaker

system is wasted in the network. Each inductor is calibrated on a sensitive electronic bridge and its value set precisely.



Loudspeaker System Components
15-inch Low Frequency Loudspeaker
5-inch Midrange Transducer
1.4-inch High Frequency Direct Radiator

Component Removal

If it should be necessary to remove the loudspeaker system components for testing or repair, disconnect the amplifier and proceed as follows:

Grille—The grille is secured to the Verona enclosure by dowel pins. To remove the grille, grasp the frame near both top or both bottom corners and gently pull the assembly away from the enclosure. To replace the assembly, reposition it on the enclosure and apply light pressure to reseat the grille frame on the dowel pins.

Low Frequency—Place the enclosure on its back on a clean padded surface. The low frequency loudspeaker is mounted from the front of the baffle panel and held in place by eight Phillips-head screws threaded into T-nut fasteners which are attached to the back of the panel. Carefully unscrew the machine screws without applying pressure that might dislodge the T-nuts. When the mounting screws have been removed, gently lift the edge of the loudspeaker frame from the baffle panel, disconnect the wires at the binding posts and remove the loudspeaker.

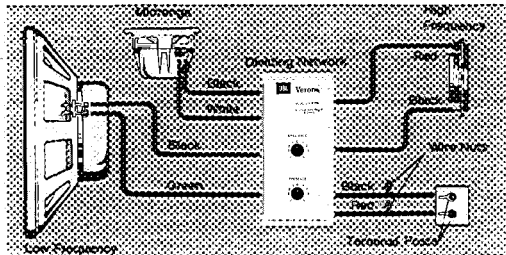
Midrange—The midrange transducer is held in place by four wood screws at each corner of its frame. Carefully remove the screws, lift the unit from the enclosure and disconnect the leads at the push button binding posts.

High Frequency—Like the midrange transducer, the high frequency direct radiator is also secured to the enclosure baffle panel by four wood screws at each corner of its frame. To remove the unit, carefully take out the screws and lift the transducer from the enclosure. The two leads from the dividing network can then be disconnected at the spade connectors on the back of the frame.

Dividing Network—The dividing network is installed behind the baffle panel and held in place by six screws threaded into T-nuts. To gain access to the network, remove the transducers as previously described, remove the wire nuts connecting the network leads to the leads attached to the binding post terminals at the back of the enclosure, remove the mounting screws, and lift the network out through the low frequency loudspeaker opening.

Replacement—Reverse the removal procedure to replace the loudspeaker system components. Mounting screws should be tightened evenly to avoid the possibility of frame warpage, and just enough to prevent air leaks between the components and the enclosure. Avoid excessive force.

Wiring—When reconnecting the wire leads between the dividing network and the components, observe the following polarity:



Although JBL loudspeakers are extremely rugged, the cone and other moving parts are subject to accidental damage. Exercise extreme caution when using a screwdriver or other tools in their immediate vicinity.

The Verona Enclosure

JBL cabinetry represents the finest quality available in the high fidelity industry, uniquely styled and solidly constructed to last a lifetime. Designed to complement the characteristics of the loudspeaker components, JBL enclosures feature tight, wood-welded, lock-mitered joints and acoustic padding to eliminate undesired resonance and warpage. The finest compressed woods, furniture hardwoods and hardwood veneers are used—carefully selected, skillfully prepared and elegantly finished. Detail work is obvious: hand-fitted joints are expertly closed; scratches, dents, gluelines and other defects are non-existent. Typical assembly line procedures are avoided; each cabinet receives all of the personal attention it must have before it can bear the JBL medallion—the symbol for quality throughout the world.

The individual panels that make up each Verona enclosure are cut from a single sheet of veneered stock, with matching solid moldings carefully selected to preserve the continuity of grain structure. All surfaces are sanded and burnished to velvety smoothness prior to the

application of a nine-step finishing process which enhances the natural beauty of the pecan and imparts a lustrous golden brown color of unusual depth. Pecan glaze is applied over a sealing coat of clear lacquer and brushed to accentuate the wood tones, adding warmth and highlights to the finish. A coat of sealer followed by a coat of semigloss clear lacquer is then applied over the glaze for uniformity. Hand distressing, using a brush and additional glaze, and a controlled application of paint spatter contribute to the richly antiqued appearance of the enclosure. Finally, a coat of semigloss lacquer is followed by a coat of flat lacquer to complete the finishing process. Before each enclosure is prepared for shipment, it is thoroughly inspected for workmanship and the finish compared to a laboratory sample to assure conformity to rigid JBL standards.

The Pecan finish will seldom, if ever, require maintenance other than normal dusting with a soft, clean cloth. An occasional coating of quality furniture polish or wax may be applied to the finish. Never apply oil or turpentine to the lacquer finish of the Verona.

Scratches, dents or serious damage should be repaired only by a qualified furniture refinisher.

in Case of Trouble

A JBL loudspeaker system responds with verbatim accuracy to the signal supplied by the audio power source; it will therefore reproduce extraneous noises just as accurately as it reproduces desired program material. Noise seldom originates in the loudspeaker system. Its presence usually indicates that one of the other components of the music system, or the program material itself, is faulty. In rare instances when something does go wrong with the loudspeaker system, one or more of the component loudspeakers will stop working altogether or a distinct rattling or scraping sound (indicating a rubbing voice coil) will be heard whenever the system is operating.

If one channel of a stereo installation is not operating, examine the loudspeaker wiring and check the balance control. If wiring instructions were followed correctly, if the connections are clean and tight, and if centering the balance control does not remedy the situation, reverse the right and left loudspeaker connections at the amplifier, taking care to turn the amplifier off before each connection or disconnection. If the previously non-

functional loudspeaker system operates, the amplifier or one of the component program sources (tuner, phono, tape deck, etc.) is malfunctioning. In the event that the suspect loudspeaker system is still inoperative, it is probably defective.

To determine whether the defect lies in the amplifier or in one of the component program sources (after verifying that the loudspeaker systems are not defective) reverse the right and left cables from the program source at the amplifier. If the original channel is still inoperative, the amplifier is defective; if the previously inoperative channel functions, the program source is defective. If the amplifier is not faulty, alternately check each program source until the defective unit has been isolated. It is unlikely that more than one program source will be faulty at any given time.

Extraneous interference such as static or radio broadcast signals can be picked up by the component devices. When this occurs, the troublesome unit can be identified by disconnecting inputs from the receiver or amplifier until the interference stops. Again, if the interference persists with none of the input devices operating through the

power source, the receiver or amplifier itself is probably defective. Shorting plugs, available from your JBL Audio Specialist, should be inserted in unused phono inputs to help eliminate stray hum or signal pickup.

Hum may be caused by locating a turntable or tape recorder directly over or underneath the amplifier or receiver. The farther the audio power source is located from the phonograph cartridge or tape heads, the less chance there will be of picking up hum. The AC leads and shielded cables should be as widely separated as possible; AC lines should never cross cables or speaker wiring. Power line interference can be further attenuated by using a heavy duty line interference filter between the audio power source and the AC wall outlet.

Fuzzy or indistinct high pitched sounds can usually be traced to the recording itself, a defective cartridge, a worn stylus or insufficient tracking force. Problems with low frequency reproduction are usually the result of room acoustics or placement of the speaker system. Excessive bass boost or incorrect loudness compensation tend to give a muddy or "boomy" quality to reproduced

music. The music system can be checked for turntable rumble or other extraneous low frequency signals by removing the loudspeaker grille assembly and observing the motion of the low frequency cone while the system is playing at high volume. If the cone continually moves in and out more than $\frac{1}{2}$ inch or so, excessive low frequency power is being fed to the loudspeaker system.

Acoustic feedback is the result of mechanical vibrations produced by excessive bass at very high volume levels. The loudspeaker system can produce enough low frequency energy to vibrate other objects in the room—including the record player and, by direct mechanical transmission, the stylus itself. These vibrations are reamplified again and again, producing very loud "rumble," or even a sustained howl that increases in intensity as the volume or bass control is turned up. Possible solutions: 1) locate the speaker cabinets as far as possible from the turntable, 2) adjust or replace the turntable shock mountings, 3) place the turntable on a rubber or sponge mat to further absorb vibrations. If the low frequency tone is still audible, it is probably the result of inherent turntable rumble rather than acoustic feedback.