

the Ezekiel

Full Range Loudspeaker



**A combination of
evolution and revolution**

The Ezekiel Full Range Loudspeaker (FRL) attains a high degree of musical realism and definition. The Ezekiel FRL is called "full range" because of the unusual wide frequency and dynamic range it produces. In addition to superb subjective performance, the Ezekiel FRL offers high power handling capability and adequate efficiency with a minimum of drawbacks and sonic deficiencies. Room acoustics were carefully considered in the design, and the FRL's sonically neutral balance does not overemphasize shortcomings in associated components and program material. The Ezekiel FRL is a 3-way, floor standing system employing unique aluminum-cone drivers. The strength and rigidity of properly designed aluminum cones dramatically reduces the cause of most types of loudspeaker distortion. Crossover design and wide physical spacing of drivers on the speaker baffle minimize phase distortion at the crossover points. The FRL occupies only one square foot of floor space and does not require special placement.

History of the Ezekiel FRL

The Ezekiel FRL is the result of a 5-year research and design project by Loudspeaker Design Corporation. The goal was to build the most accurate speaker system possible. Other design goals were that the final speaker should be practical, reliable, usable with a wide variety of audio components and affordable by almost all audiophiles. Both traditional objective test procedures and innovative psychophysical (subjective) methods were used to evaluate the hundreds of prototypes created in search of the production FRL. Extensive experience in recording and reinforcing live music further aided our final choice. The remainder of this brochure is a brief discussion of a few of the more important technical considerations which make the Ezekiel FRL a truly outstanding product.

The cause of most loudspeaker distortion

Speakers create sound waves with a vibrating diaphragm or cone. The cone or diaphragm is driven by a magnetic or electrostatic force field. These force fields are extremely linear and low in distortion compared with functioning cones and diaphragms. The greatest single source of loudspeaker distortion is the cone's inability to accurately form vibrations from the drive source into sound waves. Two major types of cone-induced distortion exist.

- **Cone break-up.** Complex forces are created in the speaker cone when it vibrates. Cone break-up is an alteration of cone shape resulting from these forces.

Alterations in cone shape produce a distorted sound wave. The effect is loss of clarity, transients, and uniform response. Phase and time delay distortions are also created when a portion of the cone flexes opposite to the direction of cone travel. The ideal speaker cone is a rigid piston that perfectly transforms every motion at the drive source into sound waves.

- **Transmission effects.** Sound travels through speaker cone materials in a manner similar to air, thus creating a flow of audible waves through the cone. This phenomenon is usually referred to as a speaker's "transmission effects." The effects are particularly noticeable at the upper end of a speaker's response where the wavelength of sound is smaller than the size of a speaker. Transmission effects are rarely beneficial and can cause substantial phase and time delay distortions when the speed of sound in the speaker cone is similar to that in air.

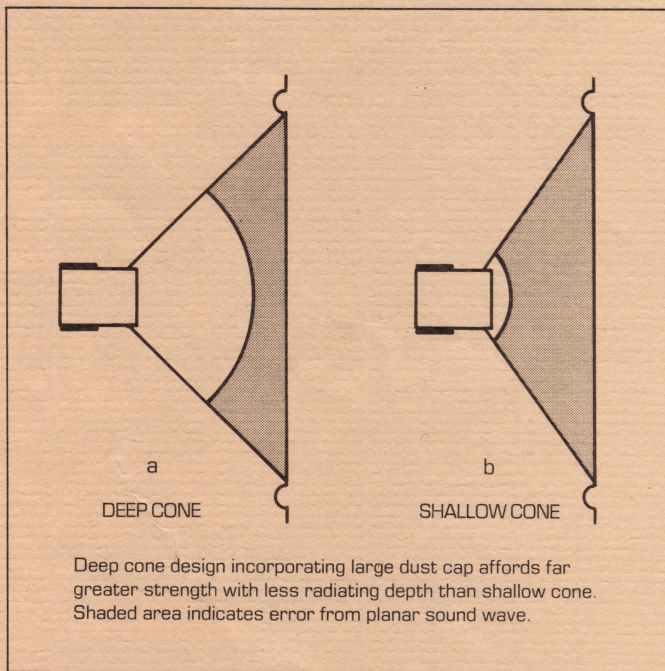
Aluminum cones

The Ezekiel FRL's most distinctive feature is its aluminum cone drivers covering the entire frequency range. Aluminum cones were chosen as the result of an extensive research program in the reproduction of live music. The fundamental characteristics of high strength and high temper aluminum alloys make them extremely suitable cone materials for woofers, mid-ranges, and tweeters, providing each driver has been properly engineered.

- **High strength and rigidity.** The strength and rigidity of aluminum is many times that of paper, fibre, mylar or plastic, and dramatically reduces the cause of most loudspeaker distortion.
- **Improved piston action.** Aluminum cones closely approximate the perfect piston. They accurately transform the motion of the voice coil into low distortion sound waves.
- **Better internal phase relations.** The speed of sound through stressed aluminum is much higher than softer cone materials, thus minimizing undesirable transmission effects. Transmission through aluminum cones occurs much more rapidly and in phase with piston action.
- **Stable performance with age.** The acoustical properties of aluminum cones are stable with age. Atmospheric conditions, temperature, humidity and time does not effect the performance of aluminum as it does other materials. The FRL will maintain the same high level of accuracy for many years.

Deep cone woofer and mid-range

Cone shape is nearly as important as cone materials. The shape can further enhance the piston-like properties of the cone and at the same time reduce phase distortion and flatten frequency response. The strongest structural shape for a speaker cone is one of deep design. The deep cone shape can be further strengthened by the inclusion of a large dust cap to brace the cone at its mid-point. A large dust cap decreases the true radiating depth, thus reducing phase distortion—the usual pitfall of deep cone design. The resulting average depth variation is negligible compared to the shortest wavelength that the speaker will produce. The increased volume of air trapped under the dust cap eliminates the pumping sounds sometimes experienced in a woofer reproducing low bass. All Ezekiel aluminum woofers and midranges incorporate those principles in their design and construction.



Toroidal dome tweeter cone

The Ezekiel tweeter cone is a toroidal dome formed from high strength aluminum. This shape combines the advantages of both dome and cone speakers. The center of the cone is a dome braced and strengthened by the epoxy bond to the voice coil. Outside the dome is a second roll which acts as additional cone area and as the dome's suspension. The overall result is a tweeter with the uniform response and dispersion of a dome but with the area and low distortion of a cone tweeter.

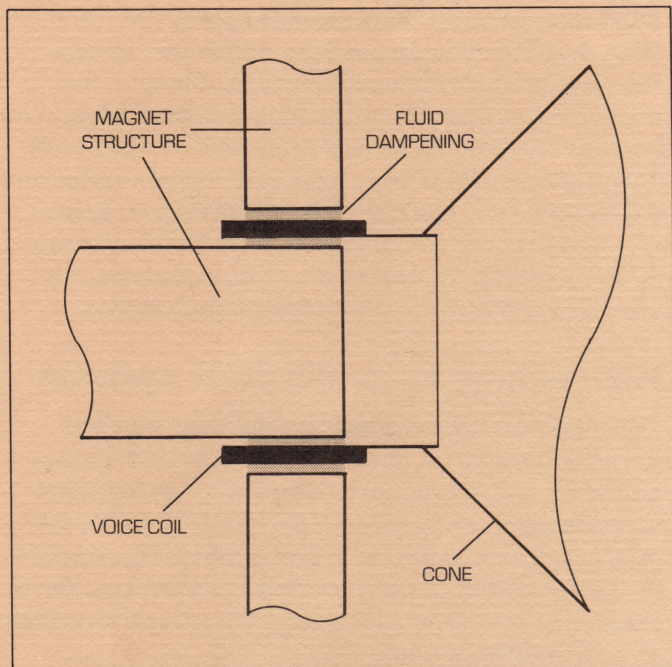
Non-resonant suspensions

Most discussions of loudspeaker suspension design have dwelled on loudspeaker compliance. Once a reasonable degree of compliance is obtained, the dampening properties of the loudspeaker's suspension become far more important to the overall quality of sound. Suspensions can create or dampen resonances. All Ezekiel cone speakers use polyurethane, foam-roll suspensions, which offer maximum dampening at all frequencies. The speaker's rear suspension is a very strong but soft and compliant cloth spider.

High energy magnetic drive systems

The magnetic drive system in a dynamic speaker vibrates the cone. It consists of the speaker magnet and voice coil assemblies. Although most magnetic drive designs are linear and low distortion for a few octaves, optimum design is particularly important to the reproduction of complex musical passages. Ezekiel magnetic drives were designed with several important considerations in mind.

- **Tuned voice coils.** The voice coil characteristics have been carefully matched to the frequency range of each speaker.
- **Increased magnetic strength.** The magnet design incorporates the use of a newly developed, magnetic silicone fluid placed in the voice coil gap. This magnetic silicone fluid transmits magnetism more efficiently than air, and increases the strength of magnetism in the gap.
- **Maximized acoustical energy.** The magnetic drive assembly maximizes the acoustical energy output from the voice coil interacting with the stationary magnetic field. Greater voice coil control results in improved transients and increased reproduction of musical inner detail—far more important than such arbitrary specifications as voice coil size or magnet weight.
- **Improved coupling to cone.** All Ezekiel voice coils are wound on aluminum or phosphore bronze forms. The metal forms are attached to the aluminum cones by means of a rigid, vibration-resistant epoxy. This construction technique assures vibrations from the voice coil will be transmitted to the cone without flexing.
- **Enlarged power handling.** The magnetic drive designs chosen afford durability for high power applications. The magnetic fluid conducts heat from the voice coil immersed in it to the metal parts of the magnet structure. The metal form also conducts heat away from the voice coil, using the aluminum cone as a heat sink.



Magnetic silicone fluid held in voice coil gap by magnetism provides both acoustic dampening and heat dissipation.

Dampened voice coils

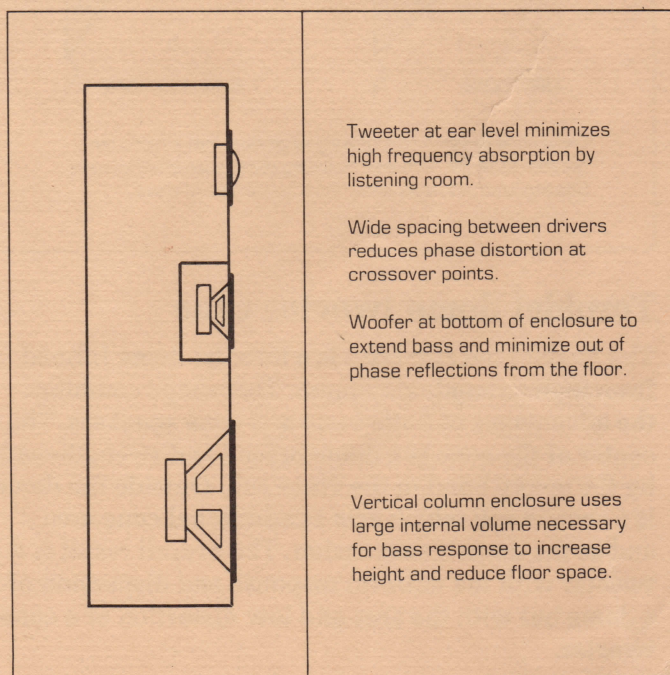
In addition to increased heat dissipation and increased magnetism in the voice coil gap, the magnetic dampening fluid improves the loudspeaker's acoustical performance.

- **Reduced resonance.** The most noticeable effect is the dampening of a speaker's fundamental resonance at the bottom of the frequency curve. The reduction of fundamental resonance also minimizes harmonic resonances that occur in an undampened speaker's operating range.
- **Flutter impedance curve.** The woofer's dampened resonance results in a flatter impedance curve and achieves similar results to transmission line and resistive-port enclosures without the transient overhang or phase difficulties commonly encountered in those designs in the lowest octaves.
- **Steeper crossover slopes.** The reduced resonance mid-ranges and tweeters electrically and mechanically aid in crossing over both speakers.
- **Improved transients.** Although difficult to measure, transient performance is enhanced by fluid dampening.
- **Better voice coil centering.** The surface tension created by the magnetic dampening fluid aids voice coil centering (lateral stability) during high output operation.

Vertical column enclosure

The reproduction of undistorted, adequately efficient low bass has always required a large internal enclosure size. This is the case whatever the acoustic design principle involved.

- **Large enclosure—minimum floor space.** The optimum shape for a large volume enclosure is a tall vertical column requiring a minimum of floor space. The FRL enclosure occupies only one square foot of floor space. The extended vertical height makes possible several highly desirable features.
- **Extended bass—improved phasing.** With the woofer positioned at the very bottom of the enclosure, the system's bass response is extended and phase reflections (longer wavelengths) from the floor are minimized. At higher frequencies (shorter wavelengths) in the vicinity of the woofer's crossover point, these phase differences aid the crossover by acoustically rolling off the top end of the woofer.
- **Ear-level tweeter.** The FRL tweeter is placed at the top of the vertical column—ear level for the seated listener. This position assures the highest degree of clarity by reducing a listening room tendency to cancel and absorb higher frequencies.
- **Reduced driver interference.** Wide spacing of the drivers on the speaker baffle dramatically reduce driver interference and phase distortion, which are most critical at the speaker's crossover points.
- **Sonically neutral balance.** The FRL has a sonically neutral balance when used as a floor standing unit in a live room and obtains maximum accuracy in normal listening environments.



Tweeter at ear level minimizes high frequency absorption by listening room.

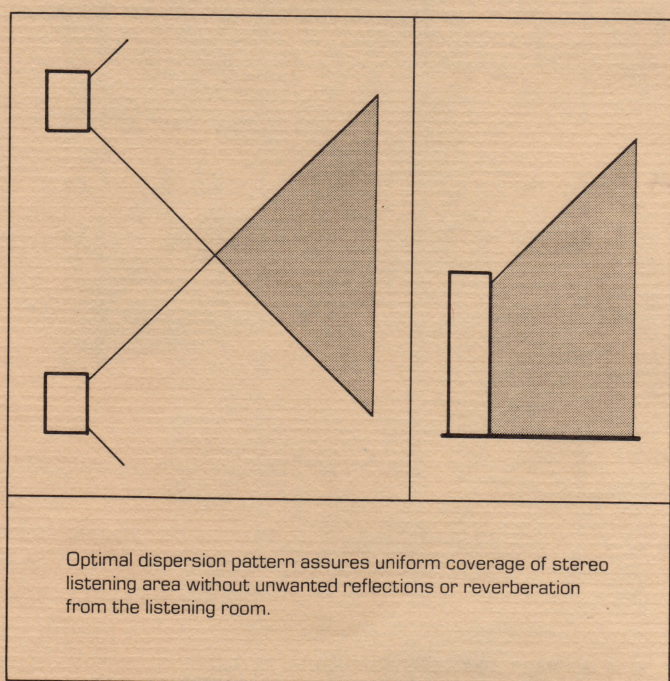
Wide spacing between drivers reduces phase distortion at crossover points.

Woofer at bottom of enclosure to extend bass and minimize out of phase reflections from the floor.

Vertical column enclosure uses large internal volume necessary for bass response to increase height and reduce floor space.

Optimal dispersion pattern

Perhaps the greatest single area of loudspeaker superstition concerns dispersion. Although uniform polar response in all planes seems to be attractive to the pseudo-scientific mind, projection of a flat, uniform response into the actual listening area is a far more important consideration. Excessive dispersion into non-listening areas can cause unwanted reverberation, time-delay distortion, and an overall decrease in reproductive accuracy. The FRL projects sound with optimal dispersion. Careful driver and baffle design affords uniform but limited dispersion, reducing reflections outside the stereo listening area.



Sound localization, stereo imaging and orchestral depth

Accurate reproduction of the musical stage requires precise sound localization, accurate stereo imaging, and a perception of sonic depth. The FRL's mid-range and tweeter placement at ear level give sound excellent localization and directionality—important to overall stereo realism. The wide spacing of drivers gives the sound a vertical spread only associated with the largest and most expensive speakers. Accurate phase relations contribute to superb stereo imaging and a sense of sonic depth. The FRL accurately reproduces the original depth of recordings. This is preferable to speaker-created, di-pole depth, which is a coloration added to all program material.

A practical product with a minimum of sonic defects

Most manufacturers of high performance, audiophile speakers overlook major practical considerations in attempts to enhance sonic performance. Those typically include reliability, uniformity, power consumption, room placement, or requirements for unusual and expensive complimentary components. Despite the number and complexity of design considerations in the final product, the Ezekiel FRL represents the simplest solution to a complex problem. The FRL possess the sonic attributes of the finest audiophile speakers, but it is a practical product without the usual audiophile drawbacks. It can be used with a wide variety of equipment with excellent results. Most audiophile speakers offering a high degree of musical definition and accuracy do so at the expense of one or more audible deficiencies. The sonically neutral FRL has a minimum of inherent audible defects and does not exaggerate deficiencies in program material. The illusion of musical realism created by the Ezekiel FRL is limited more by the quality of source material than by the performance of the speaker itself.

Rarely, if ever, can good speaker design be tied to a single revolutionary principle. Speaker design is both science and art. Not one but many factors optimized and properly integrated make a superior final product. Ezekiel speakers are largely evolutionary in nature incorporating a few revolutionary improvements. They achieve the best possible blend of all critical factors involved in high performance speaker design. Attention to detail and innovative production procedures assure the highest level of performance in a production product. The FRL is an extraordinary speaker system judged by any audiophile standards. And it is an exceptional value.

Specifications

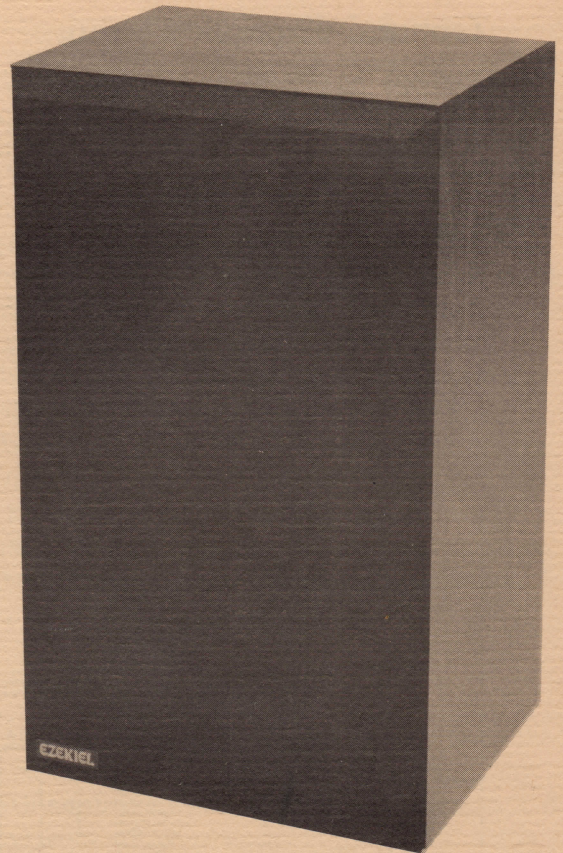
Recommended power	35 watts RMS minimum per channel 200 watts peak maximum, unclipped
Impedence	greater than 7 ohms at all frequencies
Driver compliment	12 deep cone woofer , 6 inch deep cone mid-range 2½ inch toriodal dome tweeter
Crossover network	crossover points 600 and 4000 Hz air core chokes, computer grade capacitors
Size	15¼ wide x 44 high x 10¼ deep

**For those who require
a smaller less costly
speaker.**

the Ezekiel

Wide Range Loudspeaker

A high accuracy bookshelf.



The Ezekiel Wide Range Loudspeaker (WRL) is a speaker system offering unusually high performance in a bookshelf speaker at moderate cost. The WRL is a 2-way aluminum cone speaker system incorporating the same design considerations as the FRL within limitation of size and cost. It uses a deep cone woofer and a toroidal dome tweeter to provide high definition, low distortion sound with accurate spacial relations. A superb performer by any standards, the WRL is medium efficiency and can be used with low priced

electronics. Later the electronics can be upgraded realizing the speaker's full potential. The WRL offers the unique realism of aluminum cone speakers but at lower maximum output level than the FRL. The WRL is the ideal choice when maximum accuracy is required and space considerations do not permit a larger speaker system. Although low priced within the large bookshelf category, the WRL outperforms most larger and more costly speaker systems.

Specifications

Recommended power	15 watts RMS minimum per channel 100 watts peak maximum, unclipped
Impedance	greater than 6 ohms at all frequencies
Driver compliment	10 inch basket deep cone woofer, 2½ toriodal dome tweeter
Crossover network	crossover point 1750 Hz ½ section high pass on tweeter
Size	14¾ wide x 25 high x 12½ deep
Warranty	5 year limited—parts and labor.

EZEKIEL

by

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