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WHARFEDALE E-90 LOUDSPEAKER SYSTEM

Manufacturer's Specifications
Nominal Impedance: 8 ohms.
Typical Frequency Response: 43 Hz to 18 kHz, ±3 dB.
Sensitivity: 95 dB SPL for one watt at one meter.
Power Handling: 140 watts.
Size: 44 in. (112.5 cm) H x 15 in. (38.0 cm) W x 15 in. (38.0 cm) D.
Weight: 93 lbs. (42 kg).
Price: $925.00.

The Wharfedale E-90 is a three-way floor-standing loudspeaker system. Two 250-mm (10-in.) moving-coil bass drivers are combined in a 110-liter vented enclosure to produce a maximally flat Butterworth fourth-order bass loading. The bass drivers are crossed over at 200 Hz to two 100-mm (4-in.) moving-coil midrange drivers, which carry the response to 2 kHz. A 25-mm (1-in.) compression-driver, horn-loaded treble speaker continues the response to past 18 kHz.

The enclosure stands 1125 mm (44 in.) high and is 380 mm (15 in.) wide by 380 mm deep and weighs 42 kg (93 lbs.). Wharfedale has provided a securely mounted handle at the top rear of the enclosure for ease of movement about a room.

Electrical connection is made to a recessed socket on the rear of the enclosure. A special six-meter connecting cable with mating connector and DIN plug for amplifier connection is supplied with each speaker.

The E-90 system is supplied as a left speaker and a right speaker pair. Each is clearly marked by a label mounted adjacent to the electrical connection.

A modest degree of midrange and treble equalization is provided by two 5-position rotary switches mounted on the front of the enclosure. These are accessible without removing the protective grille and are marked *Low* and *High* with index positions labelled *0*, *-1*, *-2*, *-3*, and *-4*. The operation of these controls, together with pertinent technical information, is clearly presented on a descriptive label placed on the rear of the enclosure. This, together with the descriptive brochure accompanying each speaker, allows error-free hookup of this system.

Rated at 8 ohms, the E-90 is stated as having a sensitivity of 95 dB SPL at one meter for 1-watt drive. Power handling (per DIN 45-573) is 140 watts, and Wharfedale states that the E-90 is suitable with amplifiers rated from 15 to 200 watts. Frequency response is stated to be ±3 dB from 43 Hz to 18 kHz.

Measurements

The impedance load which the Wharfedale E-90 presents to a power amplifier is shown in Figs. 1 and 2. The magnitude of this impedance, Fig. 1, reaches a minimum value of 5.1 ohms at 42 Hz. The measurement was made through the interconnect wire which Wharfedale supplies with the E-90. The nature of this impedance is such that the E-90 can be safely considered an 8-ohm system from the standpoint of amplifier drive requirements. The complex impedance plot, showing reactance as well as resistance, is shown in Fig. 2. The impedance is rather benign, as far as the reactance load which it presents to an amplifier; however, there is a 25-degree lagging angle, with a magnitude of 10 ohms, at 2.6 kHz. Since this lies in the important music overtone range, some consideration should be given to choosing a high-quality power amplifier to drive the E-90 if one listens at robust sound levels.

The free-field frequency response of the E-90, amplitude and phase, is shown in Figs. 3 and 4. These are measured under anechoic conditions at a one-meter axial position, and use a constant drive voltage corresponding to one average watt across

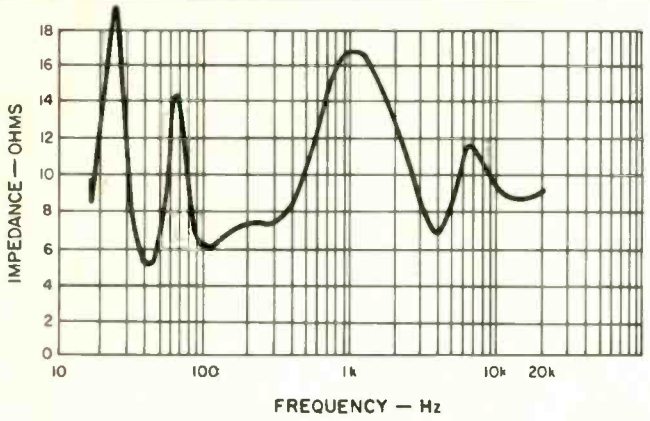


Fig. 1—Magnitude of impedance.

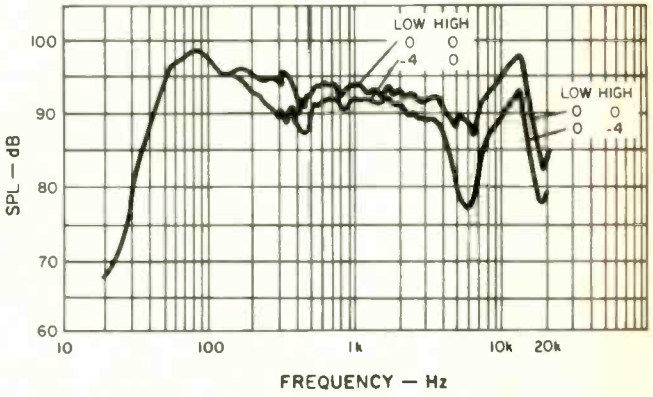


Fig. 3—Anechoic axial response at one meter with constant voltage drive corresponding to one average watt into 8 ohms.

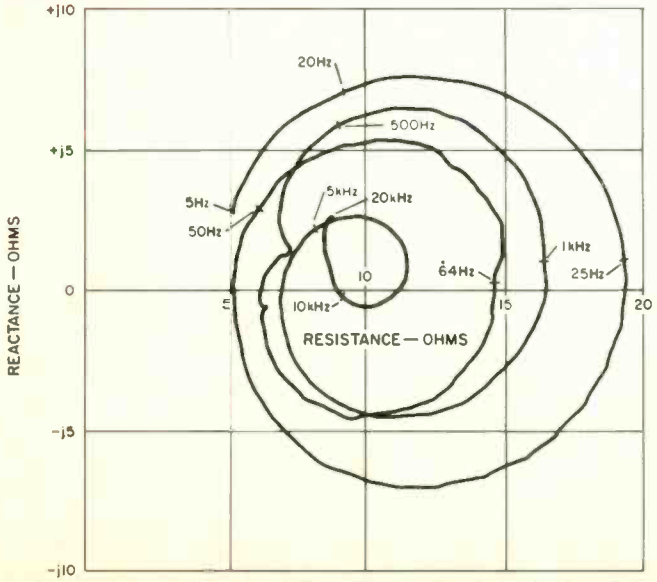
a nominal 8-ohm resistance.

The amplitude response, Fig. 3, is taken for two equalizer settings, midrange at -4 and tweeter at -4. As this measurement shows, the tweeter response does drop 4 dB for this setting, but the midrange is only reduced 2 dB. Actual acoustic crossover occurs at 2 kHz.

Sound pressure level at the equivalent of one-watt drive is very high for the E-90, averaging nearly 93 dB SPL in the midrange and rising to 97 dB at 12 kHz. This is an extremely efficient system and can give brisk sound levels with moderate-sized power amplifiers.

Low-frequency response extends smoothly down to about 45 Hz. The midrange is quite smooth, but the highest frequency performance is relatively disappointing for a system of this general high quality. An acoustic interference dip at 6 kHz is followed by a peak at 12 kHz, and this combination cannot be corrected with the equalizer controls supplied with the E-90.

Fig. 2—Complex terminal impedance.



The phase response, Fig. 4, is corrected for the air-path delay in the 1 to 5 kHz frequency range when the microphone is one meter in front of the enclosure; this delay is 3.2422 milliseconds. Acoustic transitions occur at 1 and 5 kHz. The corrected phase response shows an angle of positive 90 degrees, which identifies the midrange response as being of non-minimum phase type. The lower frequencies and higher frequencies are of minimum phase type.

The three-meter room response is plotted in Fig. 5. The microphone is placed one meter above a carpeted floor and 3 meters from the front of the enclosure. This simulates an average listening position. The frequency spectrum of the first 13 milliseconds of sound which reaches the listening position is shown in this measurement. Two configurations are measured, directly in front of the system, and 30 degrees to the side which simulates a conventional left-channel stereo listening configuration. The measurements are separated 10 dB on this plot for clarity of presentation.

Response at the listener's ear is quite uniform throughout the major part of the audio spectrum. The shallow depression near 5 kHz is due to time-delay interference between the two highest frequency drivers and progressively deteriorates off axis, as shown in this plot. This is also evident in the phase plot of Fig. 4. A more uniform listening response is obtained when listening on-axis to the E-90. This infers that the speakers should be rotated toward the preferred stereo listening position in a room.

Horizontal and vertical polar energy response, which shows the corresponding sound dispersion patterns, is plotted in Figs. 6 and 7. These measurements indicate that the preferred horizontal listening position lies within 20 degrees of the front axis. The vertical position for best listening is slightly above the geometric center of the speaker, which is approximately where the listener's ear would be for this floor-standing system. Both vertical and horizontal patterns are smooth, with no strong hot spots or interference lobes. Since a substantial part of the sound is launched upward, the E-90s should not be placed directly be-

Stereo imaging is quite good, though the illusion of depth is slightly lacking because of some vertical beaming.

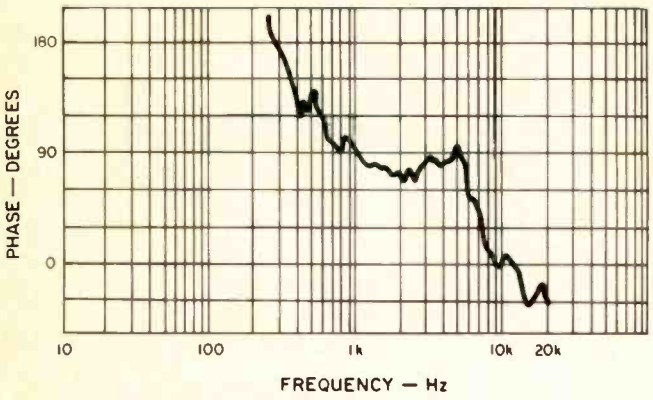


Fig. 4—Axial one-meter phase response correct for upper register air-path delay.

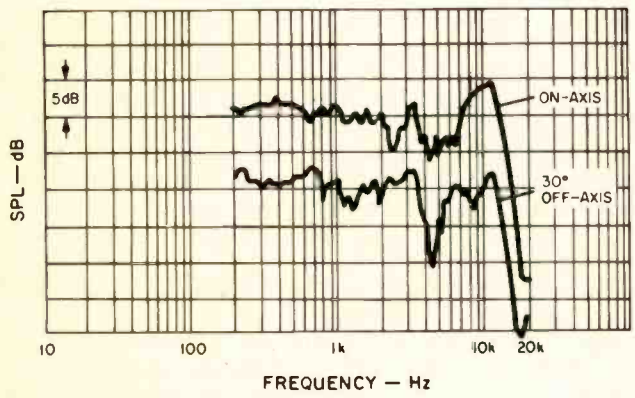


Fig. 5—Three-meter room response.

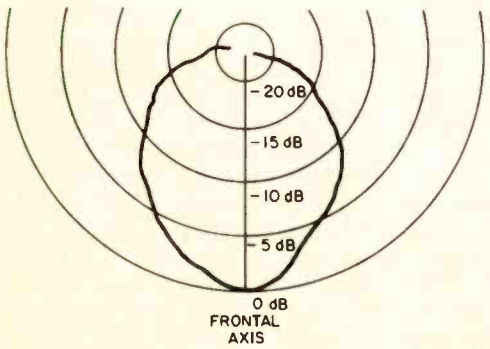


Fig. 6—Horizontal polar energy response.

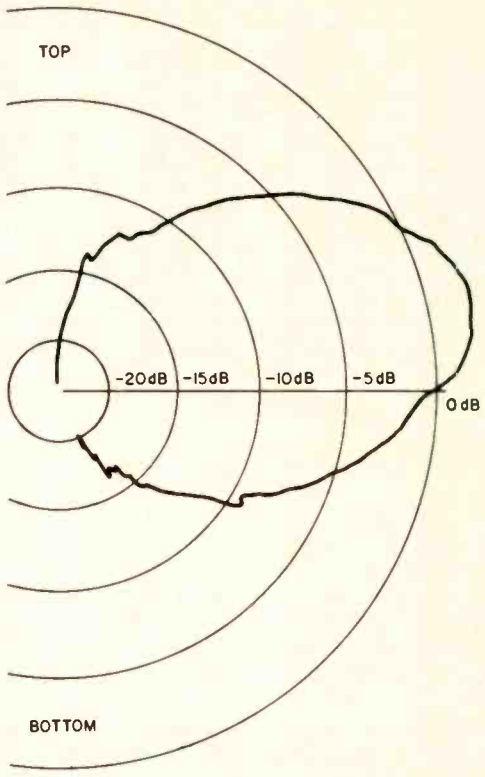


Fig. 7—Vertical polar energy response.

neath shelves or overhanging objects which could scatter sound back toward the preferred listening position.

Harmonic distortion for the tones of E_1, A_2, and A_4 (41.2, 110, and 440 Hz) are plotted as a function of drive power in Fig. 8. The tones of A_2 and A_4 are handled with very little distortion, and the E-90 ranks among the cleanest units we have tested for this property. Low E_1, however, is the Achilles heel. Harmonic distortion rises quickly with increasing drive at 41 Hz, reaching several percent at one average watt. This system should not be driven at high levels with extreme low bass.

Intermodulation distortion for tones of A_4 and E_1, mixed in equal portion, is plotted in Fig. 9 as a function of average power. Two regimes are evident, separated at about the one-watt level. Below one watt, the modulation of A_4 by E_1 (the low-frequency modulating the higher frequency) is principally amplitude modulation. Phase modulation begins to dominate above one watt, even though the total IM remains quite low at all drive levels.

Acoustic transfer gain, which is the ratio of SPL to drive voltage, is essentially constant up to 100 average watts. This was measured for tones of 80 Hz, 262 Hz (middle C), and 440 Hz (A_4). This means that substantial intensity swings will not cause timbral change.

The E-90 fares only slightly poorer in the crescendo test. Tones of 262 Hz and 440 Hz are slightly suppressed when broad band noise is superimposed at an average level 20 dB

The Wharfedale E-90s did extremely well on our energy-time test, which indicates an excellent ability to handle transients.

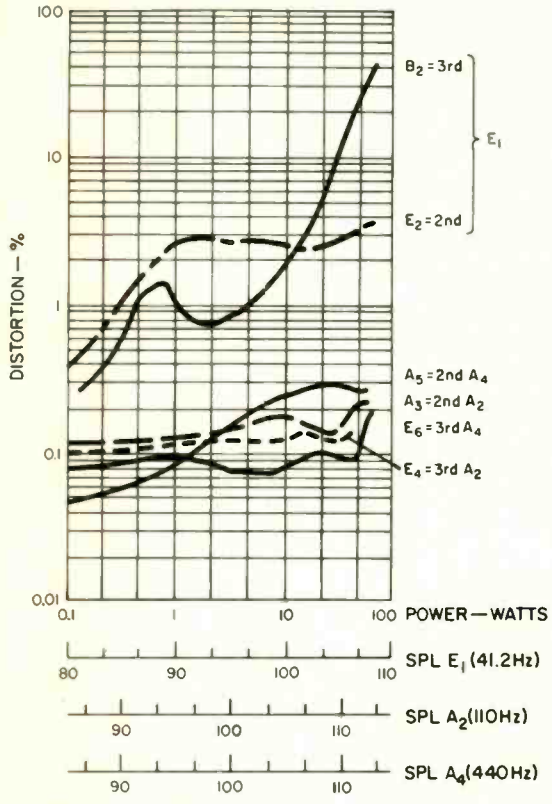


Fig. 8—Harmonic distortion for three tones, E_1 or 41.2 Hz, A_2 or 110 Hz, and A_4 or 440 Hz.

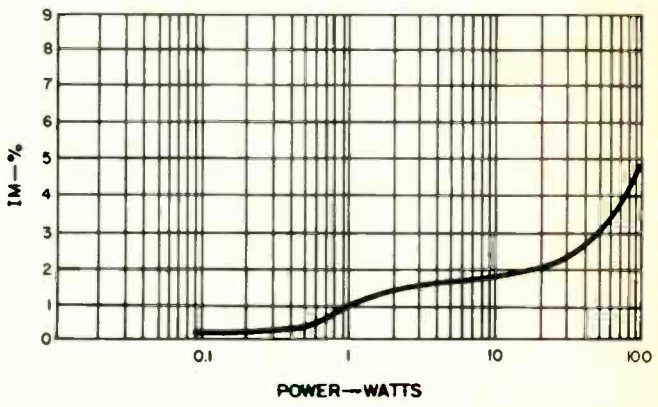


Fig. 9—IM distortion on A_4 (440 Hz) by E_1 (41.2 Hz) when mixed at a one-to-one ratio.

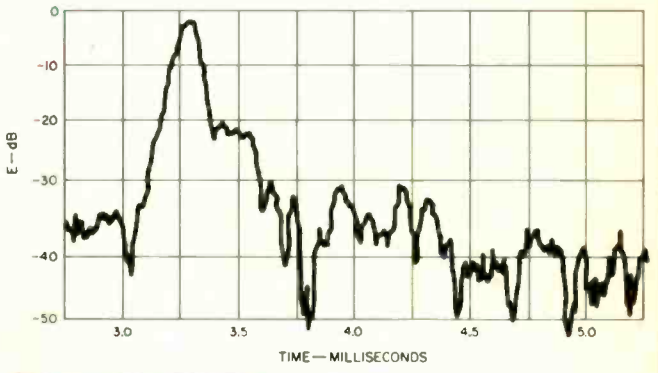


Fig. 10—Energy-time curve.

above that of the single tone. This suppression amounts to only 0.5 dB for the maximum tested noise peak of 400 watts, which implies a slight stereo drifting of inner musical voices during orchestral peaks.

The energy-time measurement for the E-90 is plotted in Fig. 10. This is a plot of the arrival time of energy for an axial microphone position one meter in front of the enclosure. The first peak of energy arrives at 3.24 milliseconds and is principally due to the tweeter, with a minor subsidiary energy spread up to 3.4 milliseconds due to the midrange. The clustering of energy, represented by this measurement, is extremely good and indicates an excellent transient response for the Wharfedale E-90s.

Listening Test

The listening test was made with the speakers flush mounted against a draped wall. This position was reached after considerable experimentation in room placement, and was found to give the most accurate sound to my ears.

The Wharfedale's have good low-low bass, but the sound is slightly dominant in the low- to mid-bass region. This tends to give a slight boominess and hangover to percussive bass.

To my ears, the E-90s are mildly strident in the upper registers, particularly on strings. For this reason, I preferred the E-90 midrange equalizer set at 0 and the tweeter equalizer set at -3. While this does reduce the extreme top end, the sonic accuracy was improved, in my opinion. Piano sounds somewhat brittle, but is spectrally balanced with this control setting.

Lateral dispersion and left-right stereo imaging is quite good. There is, however, some vertical beaming. For this reason, the illusion of depth was somewhat lacking, giving a stereo stage with adequate width but reduced depth. Because of this effect, solo instruments are accurately reproduced, but massed vocals are somewhat indistinct.

The E-90 is highly efficient and produces room-filling sound with modest amplifier power. This efficiency is coupled with an ability to produce high sound level without breakup or audible distress. The E-90 handled the famous Telarc/Holst drum excellently at high sound level, although there was some audible bass hangover.

Sonic accuracy, while not perfect, is quite good and the Wharfedale is a highly listenable system. While it would not be the first choice for a recording studio monitor system, where continuous high sound pressure levels are required, this system can be listened to, and enjoyed, for extended periods of time without fatigue. *Richard C. Heyser*