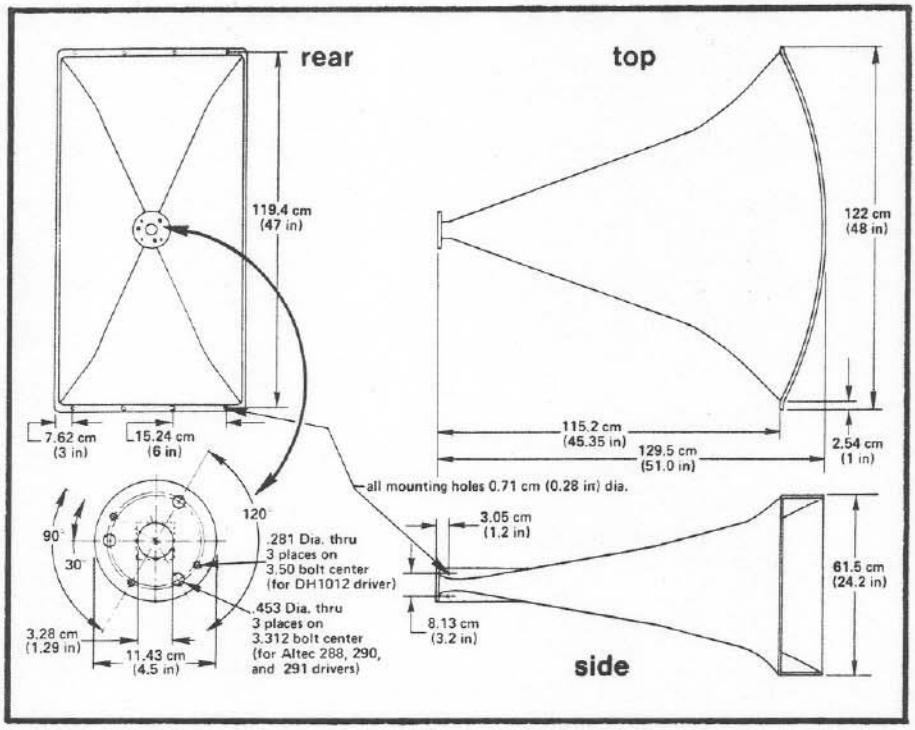
Electro-Voice®
a gulton company

Model HR4020A
40° x 20° High Frequency Horn



GENERAL SPECIFICATIONS

(All acoustical specifications taken from 1/3-octave bandwidth noise measurements.)

Horizontal Beamwidth
43° (+9°, −4°)
(−6 dB, average 400 Hz to 16 kHz)

Vertical Beamwidth
22° (+3°, −2°)
(−6 dB, average 2 kHz to 16 kHz)

Polar Pattern
Pie slice
(see page 3)

Directivity Factor R_θ (Q)
48.7 (+10.4, −12.6)
(average 1.25 kHz to 16 kHz)

(Directivity Index D_i
16.9 dB (+.8 −1.3 dB)
(10 Log R_Q, average 1.25 kHz to 16 kHz)

Usable Lower Frequency Limit
250 Hz

Recommended Minimum Crossover Frequency
300 Hz

Construction
Fiberglass reinforced plastic

Size
61.5 cm (24.2 in) high,
122 cm (48 in) wide,
129.5 cm (51 in)

Throat Diameter
3.3 cm (1.3 in)

Net Weight
20.4 kg (45 lbs)

Shipping Weight
28.6 kg (63 lbs)

R_θ and D_i vs FREQUENCY
(one-third octave bandwidths)

Freq. (Hz)	R_θ	D_i (dB)	Freq. (Hz)	R_θ	D_i (dB)
200	6.3	+8.0	2 k	50.7	+17.1
250	7.5	+8.8	2.5 k	54.7	+17.4
315	9.8	+9.9	3.15 k	59.1	+17.7
400	11.6	+10.6	4 k	49.7	+17.0
500	16.8	+12.2	5 k	51.0	+17.1
630	23.2	+13.7	6.3 k	48.1	+16.8
800	21.9	+13.4	8 k	50.7	+17.1
1 k	25.1	+14.0	10 k	48.1	+16.8
1.25 k	36.1	+15.6	12.5 k	48.9	+16.9
1.6 k	49.2	+16.9	16 k	38.1	+15.8

DESCRIPTION

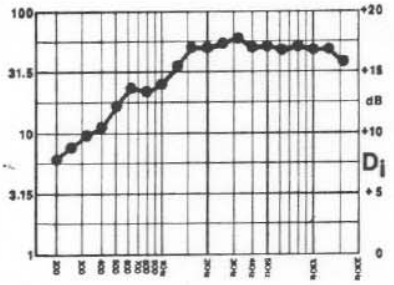
The Electro-Voice HR4020A is a lightweight, all fiberglass, narrow-angle/long-throw high-frequency horn that provides extremely precise pattern control over the full frequency range from 400 Hz to 16 kHz. The results of latest research into theoretical horn behavior by Electro-Voice engineers are incorporated in its design.[1] An optimal joining of hyperbolic-exponential (throat region) and conical flare shapes[2] provides good low-frequency response coupled with very uniform beamwidth and directivity.

Over most of its length, the HR4020A is a conical horn of rectangular cross sectio with included sidewall angles of 40° and 20°. This straight-sided horizontal and vertical wall configuration is a major contributor to the HR4020A's well-defined beamwidth and constant directivity.

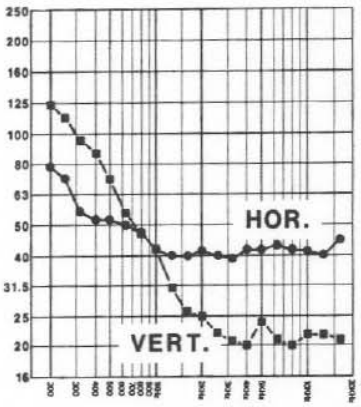
The performance of the HR4020A exceeds conventional radial/sectoral and multicellular horns in a number of important areas:

a. Mid frequencies (630 Hz to 1.6 kHz): no horizontal beamwidth narrowing or directivity increase.
b. High frequencies (6.3 kHz to 16 kHz): no beamwidth narrowing or directivity increase with increasing frequency, in either the horizontal or vertical planes.

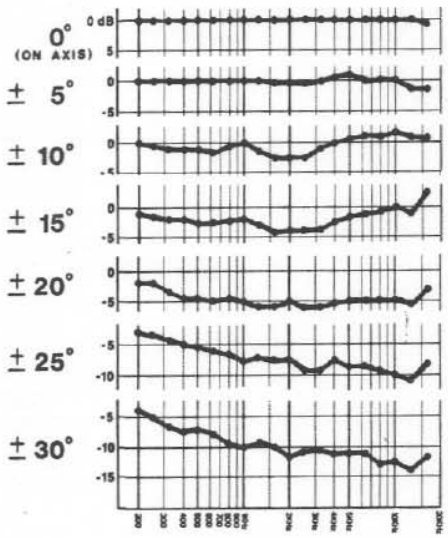
DIRECTIVITY FACTOR R_Θ (Q)



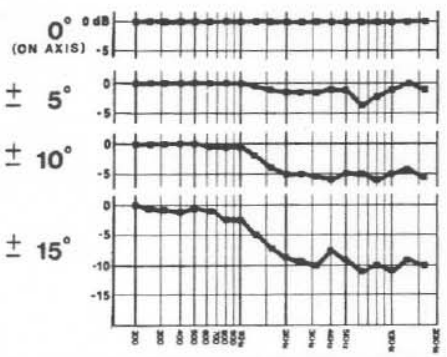
BEAMWIDTH IN DEGREES (-6dB)



HORIZONTAL OFF-AXIS RESPONSE IN dB



VERTICAL OFF-AXIS RESPONSE IN dB



FREQUENCY IN HERTZ

c. Low frequencies (250 Hz to 800 Hz): beamwidth and directivity control is maintained down to lower frequencies relative to other, smaller "long-throw" designs.

DIRECTIVITY

The axial directivty factor R_Θ (formerly Q) of the HR4020A horn was computed at each one-third octave center frequency from the horizontal/vertical polars which are displayed on the next page.[3] The graph to the left illustrates this data over the range 200 Hz to 16 kHz. Note the uniformity above 1 kHz with no large increase above 6.3 kHz. The axial frequency response of the HR4020A horn with a particular driver is in close correspondance to that driver's power response above 1.6 kHz.

BEAMWIDTH

A plot of the HR4020A's 6-dB-down total included beamwidth angle is shown to the left for each one-third octave center frequency . The horizontal beamwidth is maintained at 43° (+9°, −4°) over the range 400 Hz to 16 kHz. Vertical beamwidth control occurs only above 1.6 kHz because of the relatively short vertical dimension of the horn's mouth. Three HR4020A's may be stacked vertically, with the two outside horns functioning only in the 400 Hz to 2 kHz range, to maintain vertical beamwidth down to 400 Hz.[4]

FREQUENCY RESPONSE ON AND OFF AXIS

The one-third octave frequency response of the HR4020A, at various on and off-axis angles, was derived from the accompanying polars and is displayed to the left. All curves are referenced to the on-axis level. These responses illustrate the curves one would get with a real-time spectrum analyzer at the different angles if the horn/driver were equalized flat on axis, in an anechoic environment.

Horizontal Response

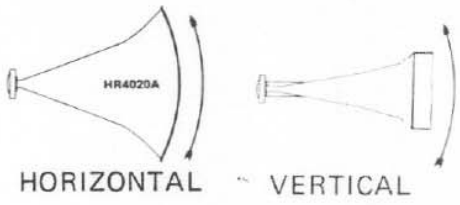
These curves indicate that the HR4020A's frequency response stays relatively flat as you go off axis horizontally except for a general decrease in level (roughly −6 dB at 20°, −9 dB at 25°, etc.). Note that the response above 6.3 kHz does not drop off as you go off axis.

Vertical Response

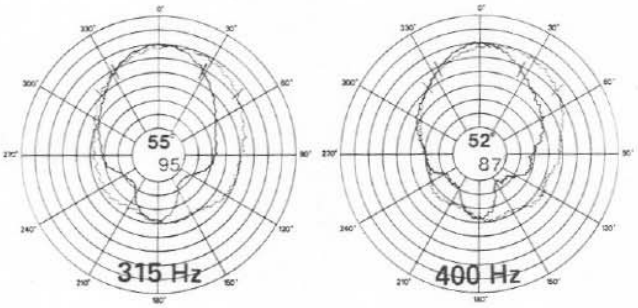
The adjoining vertical responses show that the extreme high frequencies do not droop at off-axis angles. Even at ± 15° off the vertical axis (out of the rated beamwidth of ± 11°), the response is quite flat from 1.6 kHz to 16 kHz but at a level some 10 dB down from on axis. As noted previously, a single horn only controls the response above 1.6 kHz.

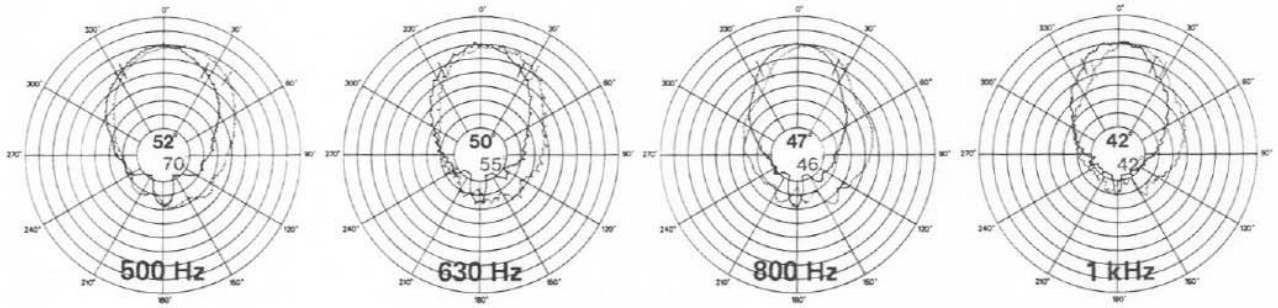
POLAR RESPONSE

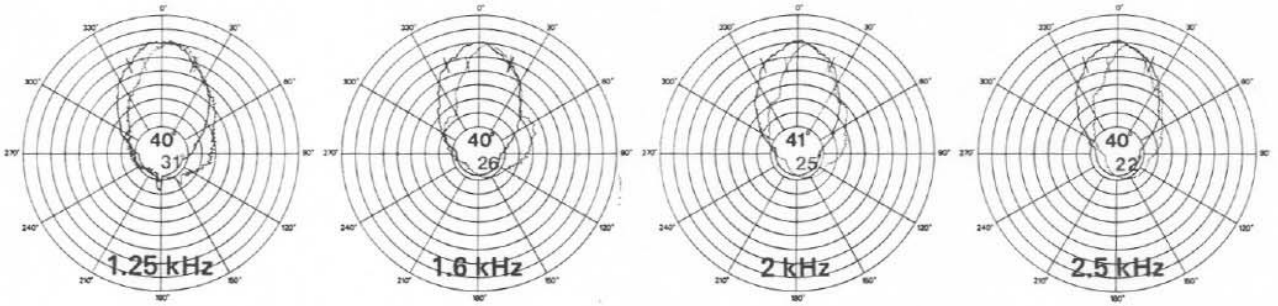
The directional characteristics of the HR4020A with driver attached were measured by running a set of horizontal/vertical polar responses, in EV's large anechoic chamber, at each one-third octave center frequency. The test signal was one-third octave bandwidth limited pseudo-random pink noise (0.5 Hz repetition rate) centered at the indicated frequencies. The measurement microphone was placed 4.5 m (15 ft) from the horn mouth, while rotation was about the horn rear driver flange. The horn was suspended freely with no baffle. The polars shown on this page display the results of these tests. Each polar is an exact tracing of the raw lab data. The effects of the pseudo-random noise are clearly shown in the cyclic variations of level with angle. The beamwidth angle and center frequency are noted on each polar.

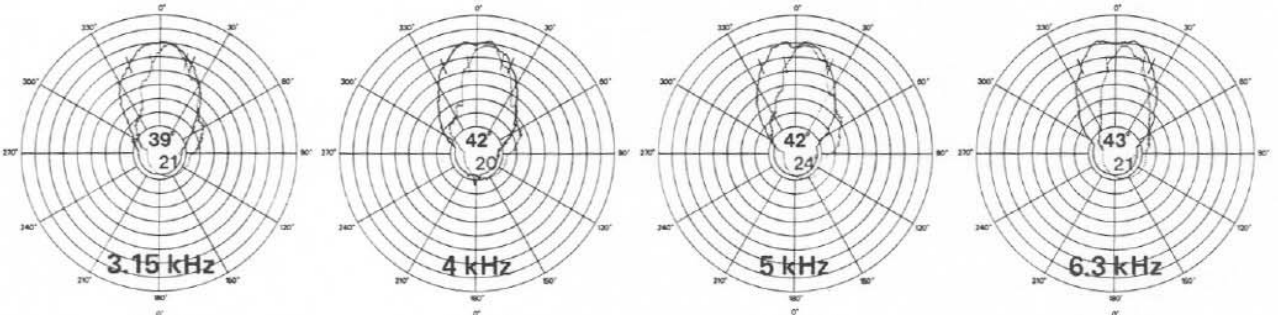


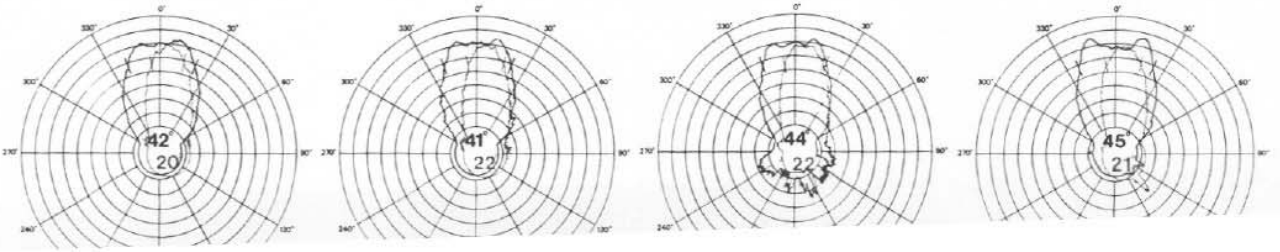
SCALE IS 5 DECIBELS PER DIVISION











HORN INSTALLATION

one of the driver mounting bolts.

The horn can also be flush mounted in a rectangular hole of 117.4 cm x 60.2 cm (46.2 in. x 23.7 in.).

HORN AIMING

The straight-sided horizontal and vertical wall geometry of the HR4020A facilitates horn aiming. A specific audience area is properly covered if a person in that area can look back into the horn, past the straight side walls, and see the horn's throat. Additionally, note that the HR4020A's axis may be aimed at the rear of a given audience area and still provide uniform coverage of closer listeners, up to 15° below the horn's axis.

DRIVERS

The HR4020A horn has been designed for use with the Electro-Voice DH1012 and (with the ADH-1 adapter described below) DH1506 high-power, wide-range drivers. Detailed information on the DH1012 and DH1506 is presented on separate engineering data sheets. The HR4020A will also accommodate the Altec 288, 290, and 291 drivers. The four-bolt DH1012 driver is mounted to the horn flange via the three smaller through holes (.281 in. diameter) and the opposite larger hole (.453 in. diameter) with the four supplied 1/4-20 bolts. The three-hole Altec drivers are mounted via the three large (.453 in. diameter) holes. Refer to the dimensional drawing.

A universal horn/driver adapter ADH-1 is available which allows other drivers with 1.9 to 3.1 cm (0.75 to 1.2 in.) dia. throats to be used. Both bolt-on and 3.5 cm (1-3/8 in.) outside diameter threaded drivers can be adapted with this kit.

WARRANTY (Limited)

materials or labor if delivered prepaid to the proper Electro-Voice service facility. Unit will be returned prepaid. Warranty does not cover finish or appearance items or malfunction due to abuse or operation at other than specified conditions. Repair by other than Electro-Voice or its authorized service agencies will void this guarantee.

For shipping address and instructions on return of Electro-Voice products for repair and locations of authorized service agencies, please write: Service Department, Electro-Voice, Inc., 600 Cecil Street, P.O. Box 186, Buchanan, Michigan 49107 (Phone: 616/695-6831) or Electro-Voice West, 8234 Doe Ave., P.O. Box 3297, Visalia, California, 93277 (Phone: 209/625-1330,-1).

Electro-Voice also maintains complete facilities for non-warranty service.

Service and repair address for this product: Electro-Voice, Inc., 600 Cecil Street, P.O. Box 186, Buchanan, Michigan 49107.

Specifications subject to change without notice.

REFERENCES

presented at the 51st Convention of *the Audio Eng. Soc.*, Los Angeles (May 1975), Preprint No.1038 (F-3).

2. U.S. patent number 4071112.

3. R_θ was calculated using the spherical shell technique as described by G.L. Wilson, "Directivity Factory: Q or R_θ? Standard Terminology and Measurement Methods," *J. Audio Eng. Soc.*, vol. 21, pp. 828-833 (Dec. 1973). Also see D. Davis, "On Standardizing the Measurement of Q," *J. Audio Eng. Soc.*, vol. 21 pp. 730-731 (Nov. 1973).

Part Number 530193 – 209

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