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TITLE	A FOCAL PROGRAM TO DETERMINE LOW-FREQUENCY LOUDSPEAKERS PARAMETERS EXPERIMENTALLY
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A FOCAL Program To Determine Low-Frequency Loudspeaker Parameters Experimentally

DECUS Program Library Write-up

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In a recent paper[1] a method was described for determining the parameters of loudspeakers in the low-frequency range to aid in the design of low-frequency baffles. The authors presented not only the methodology, but in addition, a pair of computer programs for the calculation of several loudspeaker parameters. The programs that were presented were, however, for use with remote time-shared computers. The programs were such that a FOCAL version could be formulated from them. This program, translated by R. Merrill, can be run on any 8-Family machine, a PDP-5, a LINC-8, or a PDP-12 with 4K of memory.

Following the methodology of the reference paper, in order to find the input parameters of the loudspeaker being considered, certain measurements must be made. (Note: the measurement techniques being described here are those in the reference paper and are presented only to permit use of this technique to those who do not have access to the original work. The techniques themselves are the work of Dr. Ashley and Mr. Swan. It is strongly recommended to read the original paper, if at all available.) The depth of the speaker, D4, is found by laying a bar across the speaker and measuring the depth perpendicular from the bar to the center (or deepest reference point, which might be in annulus surrounding the geometric center) using a vernier caliper. Place a known mass, M4, carefully in the cone (as a general rule, 0.25 kg is a good value for small computers; 0.5 kg for large); for best results, the mass may have several elements (i.e., it may be comprised of brass nuts) so that it can be distributed within the cone without concentrating too much weight at any one point. Before disturbing the depth measurement of the caliper, use a variable DC power supply to supply a restoring current, I2, that will return the cone to its original (unweighted) position. I2 should be recorded. Because of the high currents involved, the weights added should be as small as is practical for speakers of eight inches or less. After the current is measured, the power supply should be turned off and the new depth (with the mass in place) should be measured; this is D3.

Using a VTVM and an adjustable audio oscillator, next determine the free air resonance, X0. This is done by trning the frequency of the audio oscillator to obtain a peak reading on the VTVM. The speaker should be held at least one meter from any plane surface, otherwise, the reading of X0 will not be correct. With the frequency set at X0, the oscillator output is adjusted to make the voltmeter read 0 dB on its dB scale. The frequency is then increased to make the meter drop 3 dB; this frequency is recorded as X2. Similarly, the frequency 3 dB below X0 is found and recorded as X3. A test box constructed of 3/4-inch plywood with all six sides glued and screwed in place and the seams caulked; the box should have a volume of about 2,000 cubic inches. The box should not be lined or filled with sound absorbing materials. Its inside dimensions should be used to compute its volume, Vl. (This figure has been placed in our FOCAL program as a constant, based on inside measurements of 11 x 8.65 x 22.5 inches. If the inside dimensions of the test box are different, equation 1.3 will have to be modified accordingly.) The hold in the test box must be larger than the effective cone area; thus an adapter must be used for 8-inch speakers if the hole is made large enough for 12-inch speakers. The speaker is held tightly (or attached) to this test box, the front facing towards the interior of the box, to measure the mechanical compliance of the speaker as described above for the free air resonance, obtaining the quantity Xl. The

terms SS and D1 are the model number identification of the speaker and its advertised diameter respectively.

D1, D3, and D4 should be in inches, V1 in cubic inches (or the linear measurements in inches) and M4 should be in kilograms.

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[1] "Experimental Determination of Low-Frequency Loudspeaker Parameters," by J. Robert Ashley and Mark D. Swan, Journal of the Audio Engineering Society, Vol. 17, No. 5, October 1969.

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 WRITE ALL
C-FOCAL,1969

Ø1.1Ø SET PI=3.1415927
Ø1.2Ø TYPE !"   MECHANICAL PROPERTIES OF LOUDSPEAKERS"!
Ø1.3Ø SET V1=11.2*8.65*22.5
Ø1.4Ø TYPE !"THE VOLUME OF OUR TEST BOX IS "V1," CU.IN."!
Ø1.5Ø SET V1=V1*.Ø254↑3 ; DO 4
Ø1.7Ø ASK SS,D1,XØ,X1,X2,X3,D3,D4,M4,I2,!

Ø2.1Ø SET Q=XØ/(X2-X3)
Ø2.2Ø SET C4=.Ø254*(D3-D4)/9.8*M4
Ø2.3Ø SET B1=9.8*M4/I2
Ø2.4Ø SET C1=V1*(1.15*((X1/XØ)↑2)-1)/.14E6
Ø 2.5Ø SET D2=2*FSQT(FSQT(FABS<(C1/C4)>)/PI)/.Ø254
Ø2.6Ø SET M3=1/C4*2*PI*XØ↑2
Ø2.7Ø SET M2=M3-3.15*((D2/2)↑3)*(.Ø254↑3)
Ø2.8Ø SET V2=.14E6*C1/1.44*.Ø254↑3

Ø3.1Ø TYPE !%5,SS, %6.Ø2,D2, "   ",B1, %5.Ø4,"    "M2
Ø3.2Ø TYPE "   "%7.Ø6,C4,%6.Ø2,V2,Q,!
Ø3.3Ø GOTO 1.7

Ø4.1Ø T !" MODEL  EFF. CONE    BL PROD.    MASS    COMPLIANCE
4Ø2Ø T " OPT. VOL.     Q
Ø4.3Ø T !"          DIA. IN.    WEB-MT.      KG         M/N
Ø4.4Ø T "      CU.IN.
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