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AES Standard Playback Curve

Based on the premise that the proper approach to the problem of equalizing disc recordings and transcriptions is to standardize on a *playback* curve and to let the recording engineers make their records however they see fit, knowing that they must sound properly balanced when played on this standard reproducing characteristic, the Audio Engineering Society announces the adoption of such a curve. This announcement follows action of the Board of Governors approving the report of the Society's Standards Committee consisting of: Gordon Edwards, chairman; S. E. Sorensen, vice chairman; James Bayless, Harry Bryant, and Russell Hanson, members of the Western Division; and Theodore Lindenberg, N. C. Pickering, A. A. Pulley, and Ralph Schlegel, members of the Eastern Division. Robert Liesenberg served as alternate to Mr. Sorensen.

The standard curve, shown in *Fig.* 1, is represented by the values in Table 1.

The decision to specify a standard playback response characteristic instead of a recording characteristic was deliberate on the part of the Standards Committee. This course was chosen because of the impossible task of achieving a universal recorded characteristic compatible with all individual recording conditions and systems.

Reference to the tabulation will indicate that all points on the curve are related to 1000 cps. This reference point has been used as a standard for many years, making it evident that the maintenance and calibration of equipment would be expedited by retention of this frequency as a reference point. Furthermore, the slope of the curve at this point is sufficiently flat so that an error of 10 per cent in frequency will produce a deficiency of not more than 0.5 db.

TABLE 1

Frequency	db	Frequency	db
30	+22.5	1500	− 1.5
40	+20	2000	− 2.2
50	+18	2500	− 3
70	+15	3000	− 4
100	+12	4000	− 5.5
150	+ 8.5	5000	− 6.7
200	+ 6.5	6000	− 8
300	+ 4.5	7000	− 9
400	+ 3	8000	−10
500	+ 2	9000	−11
800	+ 0.5	10000	−12
		12000	−13.5
1000 (ref.)	±0	15000	−15.5

Permissible tolerance ± 2 db

The majority of engineers active in the recording field have felt for some time that the degree of high-frequency emphasis prescribed by the NAB transcription characteristic is excessive. The trend in modern microphones and amplifiers to a wider frequency range, approaching 15,000 cps, and the use of acoustically brighter studios have made this problem much more difficult. With this extended range, the acceleration of the reproducing stylus becomes a limiting factor. Consequently, it was deemed necessary to restrict the degree of high-frequency rise used in recording. This was accomplished by making the reproducing characteristic roll off only 12 db at 10,000 cps—approximately 3 db below the NAB specification—and continuing the response out to 15,000 cps. By doing this, the high-frequency situation has been alleviated somewhat. Since microphone and studio characteristics must be considered by the recording engineer, it is required that the sum of the electrical rise in the recording equipment and the acoustical rise in the microphone must not exceed the values shown by the reciprocal of the reproducing characteristic, unless it is intended to make the high end over-brilliant.

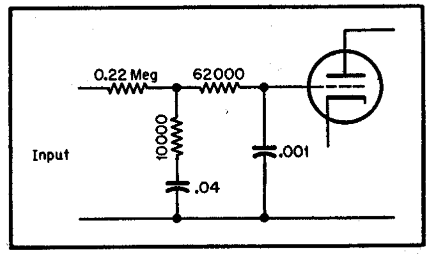

Fig. 2. High impedance network to provide standard playback curve in grid circuit of amplifier stage.

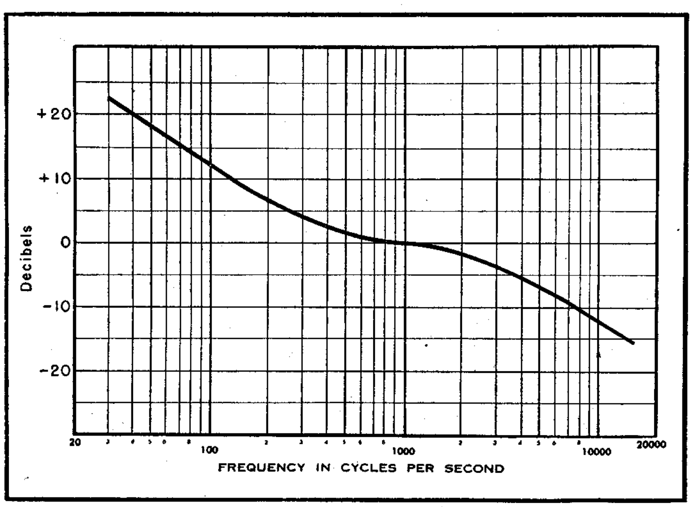

Fig. 1. Newly adopted standard playback curve.

The low-frequency characteristic was chosen to fall somewhere in the middle of the numerous low-frequency curves now in use. It is felt that the turnover frequency is low enough to keep rumble down to reasonable levels, and high enough to avoid excessive amplitude and intermodulation at low frequencies. It will be noted that no "shelving" of the characteristic at low frequencies is recommended. Again, if the recording engineer desires for some reason to have a "bassy" sound, he can easily

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AES PLAYBACK CURVE

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accomplish this by making his recording characteristic tip up at the low end; conversely, he can "thin out" the sound by the opposite procedure.

The shaping of this curve can be duplicated on a flat playback system with two sections of RC equalization, as shown in *Fig.* 2 which is one possible arrangement for use in an amplifier circuit. Both of the straight portions of the curve are slopes of 6 db per octave. The intersections of these slopes with the reference axis occur at 400 cps and at 2500 cps. At these points the response is 3 db away from the reference level. Within a tolerance of ±2 db it will be seen that all turnovers between 325 and 500 cps will fall in the area covered.

The adopted response curve (within its tolerances) is sufficiently parallel to the NAB response curve so that no problem will be encountered in the reproduction of NAB recording.

It is to be expected that the characteristic at the low-frequency end will stop rising at the 6 db/octave rate at some frequency determined by the range of the reproducing equipment. It is felt that first-class wide-range equipment will continue to 30 cps within the specified tolerance and then flatten off as rapidly as possible. Where equipment has a higher low-frequency cutoff, it is recommended that the reproducing characteristic follow the curve to its lower limit and then drop off as rapidly as possible.

On the high-frequency end, it is recommended that the reproducing characteristic be followed to the desired upper frequency cutoff, above which point the response should drop off smoothly and rapidly. In wide-range equipment it is expected that the playback characteristic will follow the curve to 15,000 cps within the tolerance specified, and then drop off rapidly above this point.

Typical Equalizing Networks

The equalizers of Fig. 3 are shown in order to facilitate the construction of these networks for use in professional installations. The Playback De-Emphasis Network is designed to give the proper roll-off characteristic in circuits of the impedances shown. If used with existing equalizers in playback circuits, the high-frequency response should be set on "flat" to obtain the proper curve.

The Recording Pre-Emphasis Network is designed for insertion in circuits of the indicated impedances ahead of the main recording amplifier. It is presumed that modifications will be made in the cutter network to obtain the desired low-frequency response. For information on the methods of adjusting these circuits, it is suggested that the engineer make inquiry from the cutter manufacturer.

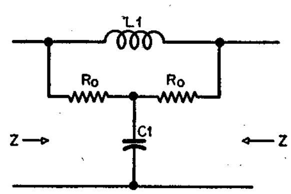
While most installations will already have some form of low-frequency equalizer for reproduction of existing types of records and transcriptions, it is possible that an entirely separate network will be required. The Playback Low-Frequency Boost Equalizer is designed to give a turnover frequency of 400 cps, with a total insertion loss (at 1000 cps) of 20 db. The half-loss point is 125 cps, and this equalizer will result in a slight decrease in response over the projected curve below about 70 cps. However, it falls within the limits down to 45 cps, and the decrease in response below that frequency may be an aid in reducing rumble.

All of these networks are designed to have constant impedance characteristics, and since they are symmetrical they may be used without regard to input or output connections. All networks shown are unbalanced, and usual transposition methods can be used to convert them to balanced networks if such are required in any particular installation.

Conclusion

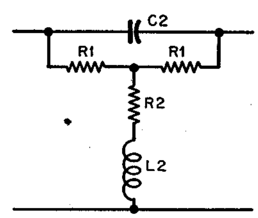
The new standard playback curve, if accepted by the Recording Industry, can achieve at long last a common platform for the reproduction of all recordings regardless of speed, groove dimensions, or manufacturer.

PLAYBACK DE-EMPHASIS NETWORK



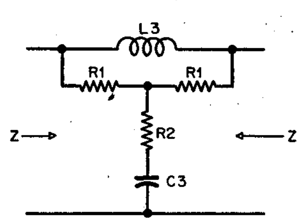
Z (ohms)	L1 (mh)	C1 (µf)	R_o (ohms)
150	9.55	0.408	150
250	15.9	0.255	250
500	31.8	0.127	500
600	38.2	0.102	600

RECORDING PRE-EMPHASIS NETWORK



Z (ohms)	C2 (µf)	L2 (mh)	R1 (ohms)	R2 (ohms)
150	.0472	1.045	123	30
250	.0284	1.74	204	50
500	.0142	3.49	408	101
600	.0118	4.19	491	121

PLAYBACK L-F BOOST EQUALIZER



Z (ohms)	L3 (Hy)	C3 (µf)	R1 (ohms)	R2 (ohms)
150	0.545	24.08	123	30
250	0.910	14.44	204	50
500	1.81	7.22	408	101
600	2.18	6.02	491	121

Fig. 3. Constant impedance networks suitable for line impedance indicated.