



FIG. 8. Spectral envelopes of two tubas at three dynamic markings.

● The spectral envelope of the stopped French horn shows a more rapid high-frequency rolloff than the other brass instruments. Figures 10 and 11 are spectral envelopes of the horn. Horn 1 was hand stopped, Horn 2 was not, whence the difference in the rolloff rates for the two spectral envelopes. For notes above about 250 cps, there is essentially only a single harmonic present for the stopped horn, the rolloff rate being about 30 dB/oct. On the other hand, the spectral envelope of the open horn closely resembles that of the trombone, the rolloff rate being only about 15 dB/oct. Figure 12 is a plot of the rolloff rate as a function of the average intensity level of the relevant scale. Note the large difference in the rolloff for the stopped and open horn, and also that the rolloff does not appear to vary substantially with the intensity level of the scale for the

radiated power is contained in the partials near and above the cutoff frequency. That is, as the note intensity increases, the low-frequency partial amplitudes decrease and the high ones increase relative to those of the partials near the cutoff frequency. The trumpet and trombone rise, and rolloff rates change similarly with average intensity of the scale, while the tuba change rather less.

● Partial's whose frequencies are below the cutoff frequency have very similar attack envelopes and reach their steady-state values within one or two cycles of each other. Partial's of increasing frequency above the cutoff frequency decrease in amplitude and exhibit increasing durations of attack modulations. Figure 13 is an idealized drawing of this characteristic. Note that the

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