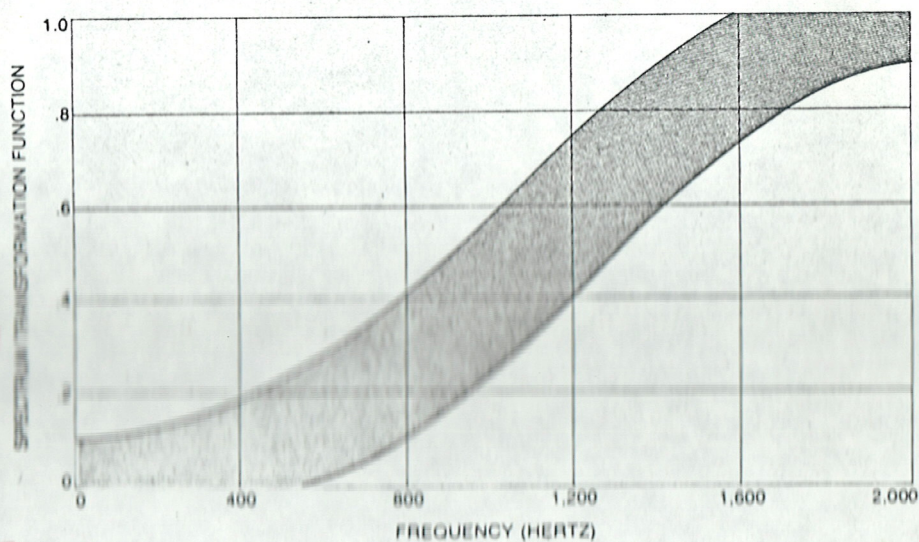


TONE COLOR OF TRUMPET is related to the way harmonic frequencies make up an increasing fraction of the total sound emitted as the player blows louder. The strengths of the various harmonic components are plotted as a logarithmic scale (decibels) against the logarithm of the strength of the fundamental component. At low and medium playing levels each harmonic lies on a straight line whose slope is approximately equal to the serial number of the harmonic. As one plays pianissimo essentially no harmonics are present in the vibration as measured in the mouthpiece. For every doubling in strength of the fundamental component the second harmonic increases from an initial tiny value by a factor of four. Similarly, the third harmonic increases in strength by a factor of eight for each doubling in strength of the fundamental, and so on. This finding corresponds to a theory developed by Walter Worman at Case Western Reserve University. At the loudness where Worman's relation begins to break down the player senses a change in "feel" and listeners are aware of a change in sound. The data that are reflected in the curves were obtained with the help of Charles Schlueter, who now plays principal trumpet in the Minnesota Orchestra.



TRANSMISSION OF TRUMPET SOUND INTO ROOM is characterized by the "spectrum transformation function," which indicates what fraction of the acoustic energy at each frequency, as measured inside the mouthpiece, is emitted from the bell. Depending on the level of play and characteristics of the instrument, the energy emitted usually falls within the band plotted here. The curve has the qualitative nature of a "treble boost" because the bell leaks energy preferentially at high frequencies. Numbers on vertical scale are arbitrary.