FREQUENCY RANGES OF MUSICAL INSTRUMENTS AND VOICES

Frequency (Hertz)

Standard pitch A4 = 440 Hz

Wavelength (meters)

Wavelength (centimeters)

Wavelength (millimeters)

Speed of sound: 343.2 m/s

Descriptions of energy excess in band

Boomy, Punchy, Fat, Impact, Slam, Muddy, Boxy, Thick, Sweet, Warm, Nasal, Harsh, Edgy, Sibilant, Bright, Airy

SUB-BASS | LOW BASS | BASS | MID-BASS/LOW MID | MID-RANGE | UPPER MID-RANGE | PRESENCE | TREBLE | ULTRASOUND

Descriptions of energy deficit in band

Thin, Sweet, Warm, Dull

Auditory critical bandwidth (Hz): 38, 47, 77, 128, 240, 650

PICCOLO
FLUTE
CLARINET
TRUMPET
FRENCH HORN
TROMBONE
TUBA
VIOLIN
VIOLA
GUITAR
CELLO
DOUBLE BASS
HARP
KETTLE DRUMS

SPEECH FUNDAMENTALS: Male / Female

VOWELS: U y,i e O ø A æ u r o p a h Ø Y Æ g

CONSONANTS: E k l t f s h "singing formant"

SOPRANO
MEZZOSOPRANO
CONTRALTO
TENOR
BARITONE
BASS
PIANO
PIPE ORGAN

dB +10, 0, -10, -20, -30, -40, -50, -60

dB(A) weighting curve

ITU-R 468 noise weighting curve

ISO 226 hearing threshold (inverted)

Middle C

Concert pitch

Explanation:

The top and bottom rows of numbers state frequencies in Hertz (periods per second) for each tone in the Western 12-tone equal-tempered scale, referenced to the standard pitch shown top center. The bottom row shows these frequencies to approximately four significant digits, while the top row rounds to the nearest integer.

The next row from the top shows the wavelength in air of each tone, using the stated speed of sound (343 m/s for dry air at 20 degrees Celcius). The second row from the bottom shows the name of each whole note and its placement on an extended piano keyboard.

The first graphical element divides the frequency range into named sub-ranges, such as "Bass" and "Treble", and indicates typical terms to express the subjective impression of too much (excess) or too little (deficit) energy in various frequency ranges. Note that too much energy in one range can sound similar to too little energy in a different range.

The row marked "auditory critical bandwidth" indicates the ear's resolution in the frequency domain. As a rule of thumb, cancellations in the frequency response that are narrower than this bandwidth may be inaudible, even if the cancellation is very deep.

The main part of the diagram shows the frequency range of various instruments and voices. In some cases, there are lighter-colored extensions to the range to indicate that some instruments or voices may extend further, e.g., a seven-string 24-fret vs six-string 19-fret guitar or a Bösendorfer grand piano. For voices, this indicates the core repertoir for a voice and the additional range that is needed in some pieces. The extreme low bass range (55-60 Hz) is for certain Russian church singers only.
The two curves across the diagram indicates the ear's sensitivity to different frequencies in two different ways. The blue dB(A) weighting curve approximates the Fletcher-Munson curves for perceived loudness at different frequencies. The red ITU-R 468 noise weighting curve approximates the subjective annoyance of noise at different frequencies. The decibel scale on the right side of the diagram belongs to these curves.

Finally, there is a row to indicate some characteristics of human voices. The words "Male" and "Female" locate the speech fundamentals of male and female voices, respectively. Vowel sounds add two or more overtones or formants that give the sound its identity. These are indicated with an upper case letter for the strongest formant and a lower case letter for the next strongest. Consonants have a single dominant frequency, which is shown with a lower case consonant. The perception of "song", as opposed to "speech", also involves additional content in the 2-3 kHz band.
The content in this diagram are collected over some time from many different sources. The errors, if any, are all mine. At some point in the future, I might put together a time domain version of this chart to indicate the resolution of the ear-brain system and the subjective effect of deviations in the time domain.