

Breakfast, Intonation Practice for Trombonists, prepared by David Schwartz

Appendix: Calculations

The intervals of the just intonation scale produce the most pleasing resultant and reinforcement pitches. These natural intervals also produce the smallest number of resultant notes and are said to be "consonant."

Columns (1) and (2), respectively, show the relationships of notes to the tonic for both the Just intonation scale and for the Equal tempered scale. In the Equal tempered scale each of the twelve semitones has a frequency which is the twelfth root of two, $2^{(1/12)}$, or approximately 1.0595, times the frequency of the next lower semitone.

Columns (3) and (4) calculate frequencies for a sample scale. For tonic at middle C equal to 261.62557, notice that the sixth, A, is 440 Hz only for the Equal tempered scale. Sounded together, A=436 and A=440 will produce four audible "beats" per second.

Columns (5) and (6) both show how much an Equal tempered pitch must be adjusted or bent, up or (down), to get to the Just intonation pitch. Memorize Pitch Bend adjustments, as shown in major and minor scale context, from the staves in the middle of page 13.

	(1)	(2)	(3)	(4)	(5)	(6)		
					(4) - (3)		$\log [(1)/(2)] \div$	
							$\log 2^{(1/1200)}$	
	<u>Just scale</u>		<u>Sample Scale</u>					
	ratio	decimal	Equal tempered scale decimal	Just scale Hz	Equal tempered scale Hz	difference ("Beats") Hz	Pitch Bend in cents	
			prev.note x $2^{(1/12)}$					
octave	2	2.0000	2.0000	C5 523.3	523.3	0.0	0	octave
seventh	15/8	1.8750	1.8877	B4 490.5	493.9	(3.3)	(12)	seventh
minor 7th	9/5	1.8000	1.7818	A4# 470.9	466.2	4.8	18	minor 7th
sixth	5/3	1.6667	1.6818	A4 436.0	440.0	(4.0)	(16)	sixth
minor 6th	8/5	1.6000	1.5874	G4# 418.6	415.3	3.3	14	minor 6th
fifth	3/2	1.5000	1.4983	G4 392.4	392.0	0.4	2	fifth
dim 5th	45/32	1.4063	1.4142	F4# 367.9	370.0	(2.1)	(10)	dim 5th
fourth	4/3	1.3333	1.3348	F4 348.8	349.2	(0.4)	(2)	fourth
third	5/4	1.2500	1.2599	E4 327.0	329.6	(2.6)	(14)	third
minor 3d	6/5	1.2000	1.1892	D4# 314.0	311.1	2.8	16	minor 3d
second	9/8	1.1250	1.1225	D4 294.3	293.7	0.7	4	second
minor 2d	25/24	1.0417	1.0595	C4# 272.5	277.2	(4.7)	(29)	minor 2d
unison	1	1.0000	1.0000	C4 261.6	261.6	0.0	0	unison