

APPENDIX FOUR

PASI OPUS 14 TEMPERAMENTS

The temperament scheme of Pasi Opus 14 is based on the regular temperament known as quarter-comma meantone. In this temperament, eleven of the twelve fifths are flattened by one-quarter of the syntonic comma (about 5.38 cents), over-compensating for the comma (about 21.51 cents) by almost three times, leaving a very wide “wolf” fifth (really a diminished sixth) between and $G^\#$ and E^b . The result: eight acoustically pure major thirds (and four intolerable), two sizes of semitones, and the diatonic note D exactly midway (at the mean) between C and E .

The irregular “well-tempered” tuning devised by Kristian Wegscheider is derived from the meantone placement of notes C , D , G and A , and eight additional notes per octave. The tuning is irregular in that there are five sizes of major thirds and five sizes of semitones (and differing numbers of other intervals as well) which create varying “key colors,” a highly prized effect in the Baroque period and linked to the Doctrine of Affections. An irregular, well-tempered tuning also called “circulating” because the circle of fifths is “closed” and it is possible to modulate around the circle and play in every key.

The following two analyses view each temperament from various angles in reference to just or acoustically “pure” intervals. A third analysis follows comparing major thirds and fifths in the Pasi temperaments to those of other historical and modern tuning systems.

Temperament Analysis: Quarter-Comma Meantone

(C, D, G and A in common with Wegscheider Well-Tempered)

Notes	Cents	Deviation from Just beginning at C
C	0.00	0.00
C#	76.05	-23.95
D	193.16	-6.84
D#/Eb	310.26	10.26
E	386.31	-13.69
F	503.42	3.42
F#	579.47	-20.53
G	696.58	-3.42
G#/Ab	772.63	-27.37
32	889.74	-10.26
Bb	1006.84	6.84
B	1082.89	-17.11

	Errors in Scales	
	Major	Minor
C	32 ++	73 -
C#	164 !!!	82 -
D	32 ++	32 ++
Eb	63 -	145 !!!
E	63 -	63 -
F	32 ++	114 !!!
F#	145 !!!	63 -
G	32 ++	32 ++
Ab	195 !!!	112 !!!
A	32 ++	32 ++
Bb	32 ++	114 !!!
B	104 !!!	63 -

Legend	
++	very good
<40	
-	poor
>60	
!!!	intolerable
>90	

Circle of Fifths						
F	-1/4 S	C	-1/4 S	G	-1/4 S	D
Bb						
-1/4 S						-1/4 S
Eb						A
						-1/4 S
						E
						-1/4 S
G#						B
-1/4 S						-1/4 S

WOLF (Circle of Fifths not closed)

Total	926	926
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Prime	minor 2	minor 3	Major 3	Perfect 4	Perfect 5	minor 6	Major 6	Major 7	Legend
C	-10.75 !!	-5.38	0.00 P	5.38	-5.38	-41.06 !!	5.38	-5.38	
Db	30.31 !!	-5.38	41.06 !!	5.38	-5.38	0.00 P	46.43 !!	35.68 !!	P
D	-10.75 !!	-5.38	0.00 P	5.38	-5.38	0.00 P	5.38	-5.38	
Eb	-10.75 !!	-46.43 !!	0.00 P	-35.68 !!	-5.38	-41.06 !!	5.38	-5.38	!!
E	-10.75 !!	-5.38	0.00 P	5.38	-5.38	0.00 P	5.38	35.68 !!	
F	-10.75 !!	-46.43 !!	0.00 P	5.38	-5.38	-41.06 !!	5.38	-5.38	
F#	-10.75 !!	-5.38	41.06 !!	5.38	-5.38	0.00 P	46.43 !!	35.68 !!	
G	-10.75 !!	-5.38	0.00 P	5.38	-5.38	0.00 P	5.38	-5.38	
Ab	30.31 !!	-5.38	41.06 !!	5.38	35.68 !!	0.00 P	46.43 !!	35.68 !!	
A	-10.75 !!	-5.38	0.00 P	5.38	-5.38	0.00 P	5.38	-5.38	
Bb	-10.75 !!	-46.43 !!	0.00 P	5.38	-5.38	-41.06 !!	5.38	-5.38	
B	-10.75 !!	-5.38	41.06 !!	5.38	-5.38	0.00 P	5.38	35.68 !!	

Temperament Analysis: Wegscheider

derived from Quarter-Comma Meantone with 20 notes per octave
(C, D, G and A in common)

Notes	Cents	Deviation from Just beginning at C
C	0.00	0.00
C#	93.55	-6.45
D	193.16	-6.84
D#/Eb	297.13	-2.87
E	390.69	-9.31
F	499.04	-0.96
F#	592.60	-7.40
G	696.58	-3.42
G#/Ab	794.51	-5.49
A	889.74	-10.26
Bb	998.09	-1.91
B	1091.65	-8.35

C	Errors in Scales		Minor
	Major	Minor	
C	30 ++		58
C#	60 -		57
D	57		48
Eb	43		51
E	58		36 ++
F	26 ++		51
F#	62 -		54
G	48		57
Ab	55		52
A	61 -		35 ++
Bb	30 ++		47
B	60 -		45

Legend	
++	very good
<40	
-	poor
>60	
!!!	intolerable
>90	

Circle of Fifths						
	F	-1.00	C	-1/4 S	G	-1/4 S
Bb						D
-1.00						-1/4 S
Eb						A
0.67						-1.00
Ab						E
-1.00	Db	-1.00	F#	-1.00	B	-1.00

Total	589	589
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Prime	minor 2	minor 3	Major 3	Perfect 4	Perfect 5	minor 6	Major 6	Major 7	Legend
C	-10.75 !!	-18.51 !!	4.38	1.00	-5.38	-19.18 !!	5.38	3.38	
Db	-0.33 P	-18.50 !!	19.18 !!	1.01	-1.00	-17.51 !!	20.18 !!	18.18 !!	P
D	-6.38	-9.75	13.13 !!	5.38	-5.38	-8.76	14.13 !!	12.13 !!	
Eb	-2.00	-20.17 !!	13.13 !!	-0.67 P	-1.00	-19.18 !!	18.51 !!	7.75	!!
E	-2.00	-9.75	17.51 !!	1.00	-1.00	-4.38	18.50 !!	18.17 !!	
F	-6.38	-20.18 !!	4.38	1.00	-1.00	-19.18 !!	9.75	3.38	
F#	-2.00	-18.51 !!	19.18 !!	1.00	-1.01	-13.13 !!	20.17 !!	18.17 !!	
G	-10.75 !!	-14.13 !!	8.76	5.38	-5.38	-13.13 !!	9.75	7.75	
Ab	-0.33 P	-18.50 !!	19.18 !!	1.00	0.67 P	-17.51 !!	20.18 !!	13.80 !!	
A	-2.00	-5.38	17.51 !!	5.38	-1.00	-4.38	18.51 !!	16.50 !!	
Bb	-2.00	-20.18 !!	8.76	1.00	-1.00	-19.18 !!	14.13 !!	3.38	
B	-2.00	-14.13 !!	19.18 !!	1.00	-1.00	-8.76	18.50 !!	18.17 !!	

Simple Comparison of Temperaments

Deviations of Major Thirds from Just Intonation (386.31 cents)

Prime	1/4-Comma Meantone	1/5-Comma Meantone	Kimberger III	Wegscheider	Kellner	Neidhardt (1724)	Equal	Pythagorean
C	0 P	4.31	0 P	4.38	2.74	5.87	13.69 =	21.51
Db	41.07	32.46	21.51	19.18	21.51	17.6	13.69 =	21.51
D	0 P	4.31	10.76	13.13	7.43	9.78	13.69 =	-1.95
Eb	0 P	4.31	16.13	13.13	16.82	15.65	13.69 =	21.51
E	0 P	4.31	19.55	17.15	16.82	17.6	13.69 =	-1.95
F	0 P	4.31	5.38	4.38	7.43	9.78	13.69 =	21.51
F#	41.07	32.46	19.56	19.18	21.51	17.6	13.69 =	21.51
G	0 P	4.31	5.38	8.76	7.43	7.83	13.69 =	21.51
G#	41.07	32.46	21.51	19.18	21.51	17.6	13.69 =	21.51
A	0 P	4.31	14.18	17.51	12.13	13.69 =	13.69 =	-1.95
Bb	0 P	4.31	10.76	8.76	12.13	13.69 =	13.69 =	21.51
B	41.07	32.46	19.56	19.18	16.82	17.6	13.69 =	-1.95

Deviations of Perfect Fifths from Just Intonation (701.96 cents)

Prime	1/4-Comma Meantone	1/5-Comma Meantone	Kimberger III	Wegscheider	Kellner	Neidhardt (1724)	Equal	Pythagorean
C	-5.38	-4.31	-5.38	-5.38	-4.7	-3.92	-1.96 =	0 P
Db	-5.38	-4.31	0 P	-1	0 P	0 P	-1.96 =	0 P
D	-5.38	-4.31	-5.38	-5.38	-4.7	-3.92	-1.96 =	0 P
Eb	-5.38	-4.31	0 P	-1	0 P	-1.96 =	-1.96 =	0 P
E	-5.38	-4.31	0 P	-1	0 P	-1.96 =	-1.96 =	0 P
F	-5.38	-4.31	0 P	-1	0 P	0 P	-1.96 =	0 P
F#	-5.38	-4.31	-1.96 =	-1	0 P	0 P	-1.96 =	0 P
G	-5.38	-4.31	-5.38	-5.38	-4.7	-3.92	-1.96 =	0 P
G#	35.68 !!!	23.69	0 P	0.67	0 P	-1.96 =	-1.96 =	0 P
A	-5.38	-4.31	-5.38	-1	-4.7	-3.92	-1.96 =	0 P
Bb	-5.38	-4.31	0 P	-1	0 P	0 P	-1.96 =	0 P
B	-5.38	-4.31	0 P	-1	-4.7	-1.96 =	-1.96 =	-23.46