NOTES ON TUNING

The following notes were written as for a bagpipe in G; the principles apply of course to a bagpipe of any pitch, but for the specifics you will need to make an appropriate adjustment for the pitch of your instrument.

If you want to stand a chance of playing in tune with others, especially fixed pitch instruments such as accordions, melodeons, or keyboards, you need to make sure that your pipes are tuned to the correct standard. This is usually specified as A=440Hz at 20°C/68°F. The reason for including temperature in this procedure is that pitch in wind instruments is affected by the speed of sound, which in turn is affected by the temperature of the air (and humidity, and air pressure – but there is only so far it is worth going; humidity you might need take into account if it is extreme). The pitch variation is approximately 1% per 5.5°C or 10°F. So at 22°C you should allow for your pipes to play nearly 7 cents sharp, and at 28° you are up to 25 cents, or a quarter of a semi-tone. Of course my workshop is rarely at exactly 20°C, so I keep a thermometer and temperature compensation chart (see Table 1 below) over my bench, and calibrate my tuner accordingly.

I use my tuner in electronic drone mode, operated by a footswitch, as a rough guide when first testing reeds, then when making final adjustments I make sure the drones are perfectly tuned to the tuner, and test the reed in the instrument. Thus the tuner, and therefore the drones will be tuned to a G which is an equal temperament G below A=440Hz, adjusted for temperature.

The issue of absolute pitch, that is, whether your G is the same as someone else's G is a separate one from that of whether the notes of the chanter are in tune with the drone, or to put it another way, have the correct relationship with the tonic, the keynote. If the chanter is correctly constructed and the reed is a good one then all should be well. But in an imperfect world, there may be occasions when you might question whether one or two notes are quite right.

In case you think of tuning the chanter scale against the tuner, using the tuner in its listening mode, remember that the scale given by a standard tuner is normally an equal temperament one. I say 'normally' because it is possible to find (more expensive) tuners which can be calibrated to a range of historical temperaments. On the other hand the chanter scale is a just scale. This means that a correctly tuned chanter will show 'out-of-tune' readings on the tuner. Table 2 below gives the amount in cents by which the two scales differ. If you wish to use your equal temperament tuner for checking chanter tuning, the chart shows the offsets you need to take into account.

The frequency of each step of the just scale is chosen to give best consonance (in-tuneness) with the tonic, the keynote. This is a mathematical relationship, the basics of which are explained in Table 3. But tuning is also of course judged and appreciated physically and correct tuning gives physiological satisfaction, which must be something to do with the fact that the frequencies of the chanter and drones are agreeing with each other. By all means use the tuner to check your chanter scale, but in the end the ears are the best judge because they naturally prefer consonance and it is good to train them to hear the niceties of perfect tuning.

That the chanter scale is a just scale needs slight qualification. Because F natural at the top of the scale is a cross-fingered note, the tuning of both this note and F# is determined mainly by the size of the top finger hole. If F natural is made just, then F# will be too flat to be credible, so a sharper tuning than just tuning is adopted for F natural. In fact an equal temperament tuning for F and F# works quite well, and the ear is less discriminating when listening for small intervals.

Drones and the second octave: passing into the second octave involves a change of pressure. If the

drones are changing pitch with pressure, then assessing the tuning of notes in the second octave will be impossible by reference to the drones. It's easy to be fooled by this. So if you have doubts about second-octave tuning, make sure that the drones are remaining completely steady under the increased pressure required to reach and stay in the second octave.

Although as mentioned above the absolute pitch of the chanter and the tuning of the scale are separate issues, they are also interdependent. For example, it is possible for the chanter to play a scale in which each note is in the correct relationship with all the others, but the overall pitch is either high or low. Conversely it is possible for, say, most of the scale to be at the right pitch, with one or two notes a little high or low. In my experience the note D is the best pitch reference. If that note is correctly tuned, and the reed is good, then the rest of the scale should be good. On the other hand if, say, B is low, this usually indicates that scraping has been taken a little too far, and you may be able to correct matters by clipping a small amount from the tip. If you have a poor C# or none, then you may need to weaken the reed a little by sanding or scraping, or open it.

Table 1

TEMPERATURE COMPENSATION			
Fahrenheit	Celsius	Herz	Cents
60	15.6	436.5	-14
61	16.1	436.9	-12
62	16.7	437.4	-10
63	17.2	437.8	-9
64	17.8	438.2	-7
65	18.3	438.7	-5
66	18.9	439.1	-3
67	19.4	439.6	-2
68	20	440	0
69	20.6	440.4	2
70	21.1	440.9	3
71	21.7	441.3	5
72	22.2	441.8	7
73	22.8	442.2	9
74	23.3	442.6	10
75	23.9	443.1	12
76	24.4	443.5	14
77	25	444	16
78	25.6	444.4	17
79	26.1	444.8	19
80	26.7	445.3	21

Table 2

Comparison of Just and Equal Tempered Intervals - Scale of G									
	G	A	B	C	D	E	F	F#	G
EQUAL TEMPERAMENT									
Interval in Cents	0	200	400	500	700	900	1000	1100	1200
Note Frequency (Hz)	392	440	493	523	587	659	698	740	784
JUST INTONATION									
Interval in Cents	0	204	386	498	702	884	971	1088	1200
Note Frequency (Hz)	392	441	490	522.7	588	653.3	686	735	784
Difference in cents	0	4	-14	-2	2	-16	-29	-5	0
Difference in Hz	0	1	-3.9	-0.6	0.7	-5.9	-12.5	-5	0

Table 3

Table of Drone Pitches and Harmonics for Bagpipe in G							
		Drone Harmonics Hz	Bass Drone in G	Baritone Drone in D	Tenor Drone in G	Alto Drone in D	Treble Drone in G
		1960	-20		-10		
		1568	16		8		4
		1470	15	10		5	
		1372	14		7		
		1323		9			
		1274	13				
		1176	12	8	6	4	3
Chanter		1078	11				
Scale		1029		7			
Note	Hz	980	10		5		
		882	9	6		3	
G	784	784	8		4		2
F#	735	735		5			
F	686	686	7				
E	653	1960/3					
D	588	588	6	4	3	2	
C	523	1568/3					
B	490	490	5				
A	441	882/2		3			
G	392	392	4		2		1
		294	3	2			
		196	2		1		
		147		1			
		98	1				