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Tuning matters too (Jun 2019)

This article is a more in-depth explanation of various aspects of tuning and is aimed at players who are interested in instruments used before 1945ce (another information sheet about tuning, with particular relevance to simple system 'Irish' session and Marching Band Flutes can be found with the Flute information sheets).

There are three aspects to the tuning of any instrument – the pitch centre, the temperament, and the intonation.

The Pitch centre

The pitch centre refers to the tuning of the instrument as a whole. The pitch centre of modern instruments is usually tuned in reference to the frequency of A = 440 hertz, which is referred to as 'concert pitch', this means the (theoretical) positions of the tone holes are determined by a mathematical formula that multiplies or divides the figure 440. If you test your (modern) instrument against a tuning meter calibrated to A 440(hz) then each note within the normal compass of the instrument (i.e. on a Flute - Low D to 2nd register b) should be within +/-20 cents of zero (assuming your instrument has been set up correctly and is tuned to equal temperament).

If your instrument was designed with a pitch centre of A=335 hz the positions of the tone holes are determined using the same mathematical formula but this time based on the figure 435; if you test the instrument against a tuning meter calibrated to A 435(hz) then again, assuming your instrument has been set up correctly and is tuned to equal temperament, each note should be within +/-20 cents of zero (within the normal compass of a Flute - Low D to 2nd register b). If your instrument was designed with a pitch centre of A 335 (and has been set up for this and is tuned to equal temperament) and you test it against a tuning meter calibrated to A 440 then your instrument would sound consistently flat, though in fact it the instrument would be in tune with itself.

The modern concert pitch of A 440 has only be widespread since 1945, prior to that date the actual frequency for A could be anywhere between 392 hz (French Baroque pitch) and 466 hz (Baroque church pitch).

Temperament

Temperament is a very complex issue but put *very* simply it is the relative size of each semitone going up a chromatic scale.

On instruments that have been tuned to the 'equal tempered' scale (also called equal temperament) - each semitone step *sounds* the same size as the instrument is played from its lowest note to its highest note. On instruments that have been tuned to *unequal* tempered scales some semitones sound 'bigger' or 'smaller' than others. Temperament is measured in cents – there are 1200 cents in an Octave. In equal temperament each semitone step is exactly 100 cents; in unequal temperament any one semitone step may be smaller or larger than 100 cents but together the steps still add up to 1200 cents.

There are various forms of un-equal temperament which can be used when tuning an instrument and some are relatively simple to calculate mathematically. Players of Early music (Medieval, Renaissance, and Baroque) and some folk music forms sometimes want their instruments to be made at pitches other than 440 and with an unequal temperament to authentically reproduce the music as originally heard when it was first created. If all the instruments of an ensemble are using the same un-equal temperament, and if the music played stays in a few home keys, and if the harmony used is relatively simple - then the intervals between notes in the harmony sound

more beautiful (better than if played in equal temperament) and the notes sound in tune; however if the music wanders from these few home keys the intervals in the harmony can be the wrong size and sound out of tune (significantly worse than equal temperament).

This is analogous to a flat paper map – a flat paper map is relatively simple to produce for a local area – but the further you move away from the centre of the map the more the distances distort – if you travel very large distances you find that the local flat paper maps do not all link up properly – this is because the world is round not flat. In music the further you move from the home keys on instruments tuned to un-equal temperament the more the intervals do not join up. Equal temperament is musical tuning's version of the globe – it allows travel from any key to any other key with all the intervals linking up and all the notes sounding in tune – however in any single key the harmony does not sound quite as beautiful.

Since 1917 the vast majority of the 'Western' world's instruments have been tuned to equal temperament because it is essential for most forms of classical and popular music.

Today, the vast majority of players expect their instruments to be tuned to equal temperament; this assumption is so great that most people are not even aware they are making this assumption! However instruments made prior to 1917 (and copies of these instruments) may well have been tuned to one of the many unequal tempered scales used by instrument makers.

Intonation

Intonation is the tuning of the individual notes. If your instrument has been set up correctly, is tuned to equal temperament, and its pitch centre is modern concert pitch; then, when you test your instrument against a tuning meter calibrated to A 440, you will still find some notes exactly in tune and others slightly out of tune – this is normal and is the result of inevitable compromises that have to made when building the instrument (that is why the mathematical formula can only describe theoretical positions for tone-holes rather than the actual positions). The normally accepted tolerance for a modern instrument is +/- 20 cents from zero for each note - the player is expected to bring notes into tune by subtle variations in their embouchure (older instruments may have an even wider tolerance – requiring not only variations in embouchure but also rolling of the head-joint and complex cross fingerings).

Note that when you are tuning to a note you are effectively calibrating your embouchure. You must always tune to a note that is at zero on a tuning meter when you play the note with your normal relaxed embouchure; for instance if you tune to A, and it happens to be 10 cents sharp on your instrument, then you will use your embouchure to flatten the note 10 cents, if you maintain this underlying bias you will also flatten all other notes 10 cents – if some of those notes are already 20 cents flat then you will be playing them 30 cents flat - therefore outside the +/-20 cents tolerance. In practice you would probably subconsciously sharpen these flattened notes to some extent, but the point is you will find that keeping in tune more difficult than is necessary, therefore it would be better to tune to another note on your instrument that you know is exactly in tune.

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