

INTONATION FOR WINDS

Have you wondered why, when you KNOW that you're playing in tune, the conductor will tell you to play a little flatter or sharper? And then, when you do so, suddenly the chord sounds fantastic?

Our wind instruments are tuned to "equal temperament", like a piano. What does this mean? Equal temperament means that the ratio of the pitches of all notes to that one step up is the same. The relationship of C to C# is the same as the relationship of E to F or A# to B. How is this achieved?

The relationship between any two notes an octave apart is 2:1 – that means that if concert A is precisely 440Hz then the A an octave above it is 880Hz and that an octave below is 220Hz. There are 12 semitones in an octave and if we want to divide the octave into 12 equal steps (i.e. equal temperament), then each step is the 12th root of 2 higher than the preceding one (if you recall your high school math, this is called a geometric progression). So the pitch of the 13 semitones starting with concert A are:

440, 446.2, 493.9, 523.3, 554.4, 587.3, 622.3, 659.3, 698.5, 740.0, 783.0, 830.6, 880.

This is how a piano is tuned.

The 12th root of 2 is 1.0594631..., an irrational number, meaning that you cannot calculate it by dividing one whole number into another. And therein lies the rub!! For two pitches to sound "in tune" with each other, the ratio of their pitches must be a ratio of small whole numbers. This is called "just intonation", and is what we strive for because it sounds consonant to our ears.

Let's start with octaves – the ratio is 2:1 so that works well with equal temperament.

The next simplest interval is the perfect 5th which has pitch in the ratio of 3:2. If A is 440 then the perfect 5th, E, 7 steps up from A should be 660. But in equal temperament it is 659.3, a small, but not insignificant difference. If you are playing the perfect 5th in a chord and you play correctly according to your tuner, you will be slightly flat and will be asked to play a little higher.

The ratio of 4:3 is a perfect 4th. The perfect 4th of A is D and should have a pitch of 586.7Hz. The tuner will indicate 587.3Hz as correct, so you need to play a little lower to be in tune.

The major 3rd has pitch in a ratio of 5:4. The major 3rd of A is C# and should have a pitch of 550Hz. But the tuner will indicate that 554.4Hz is “correct”, which is very far from what will sound good. You will need to play much lower to be in tune.

The minor 3rd corresponds to a ratio of 6:5. The minor 3rd of A is C and should have a pitch of 528Hz, versus the tuner that will indicate 523.3Hz as correct, so you will need to play much higher to be in tune. Of all the intervals, the minor 3rd needs the most adjustment by the musician in order to play in tune.

So, to be in tune, the pitches are dependent on where in the scale they lie – and this will change in the music as the key changes! To make it even more challenging, even the just intonation described above should be modified to take into account the context of the note e.g. leading notes sound better when played sharper than just intonation!!

So next time the conductor asks you to play higher or lower, don't be surprised if this doesn't correspond to your tuner, as the tuner is calibrated for equal temperament.

Many tuners have little arrows on the dial (see photo) to show where the major 3rd (left) and minor 3rd (right) are located for just intonation.



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