

## TUNING THE DOUBLE HORN

A Practical Approach

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One of the biggest problems facing a young horn player and his non-horn playing band director is the tuning of the double horn. The double horn has eight or more slides which must be properly adjusted before the instrument can be played in tune with itself or with other instruments.

Experienced horn players tune their horns by trial and error, adjusting the slides when they notice discrepancies in intonation. The process takes quite a while and the slide positions continue to fluctuate until the player achieves a satisfactory compromise.

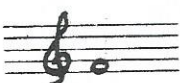
There are two factors in this compromise: 1) Due to the basic nature of brass instruments it is necessary to rely on the notes of the natural harmonic series for a great number of pitches. The notes of this series are frequently at odds with the equal tempered scale and therefore an equal tempered brass instrument is not possible. 2) The valve system in use today consists of a set of dependent valves which serve to add tubing to the basic instrument. This additive process works well when the valves are used separately, but when they are combined, a problem develops. Valve slide lengths are in a fixed proportion to the length of the whole instrument. When the instrument is lengthened through the use of another valve, this proportion is lost.

Since the experienced horn player has worked out the compromises on his instrument it is usually possible for him to pick up another instrument and tune it in much the same way his own instrument is tuned using his ear alone. Most students' horns are tuned in this manner. But what of the horn student who is not in regular contact with an experienced player?


The following is a procedure for tuning the double horn which can be done by anyone who can play the horn (even in a modest way), and is simple enough for a Junior High School student to understand.


Step 1) Tune the open B<sup>b</sup> horn to a reliable pitch source by matching the

horn to the source on either  if the source is a piano,


or  if the source is a B<sup>b</sup> tuning bar or electronic


tuner. Be sure to adjust only the main tuning slide when doing this.


2) Match the pitch of the F horn to the pitch of the Bb horn by playing  on the two horns and adjusting the F horn tuning slide until the two pitches match. (Note: On horns with Bb tuning slides it may be necessary to pull out this slide before it will be possible to match the two horns. When this is necessary, Step 1 should be repeated.)


3) Play  open on the F horn and then with first valve on the F horn, adjusting the first F horn valve slide until the two pitches match.

4) Match the pitch of the Bb horn first valve to the pitch of the F horn first valve by playing  on the two horns and adjusting the first Bb horn valve slide until the two pitches match.

5) Play  open on the F horn and then with first and second valves on the Bb horn, adjusting the second Bb horn valve slide until the two pitches match.

6) Match the pitch of the F horn second valve to the pitch of the Bb horn second valve by playing  on the two horns and adjusting the second F horn valve slide until the two pitches match.

7) Play  with second valve on the F horn and then with second and third valves on the Bb horn, adjusting the third Bb horn valve slide until the two pitches match.

8) Match the pitch of the F horn third valve to the pitch of the Bb horn third valve by playing  on the two horns and adjusting the third F horn valve slide until the two pitches match.

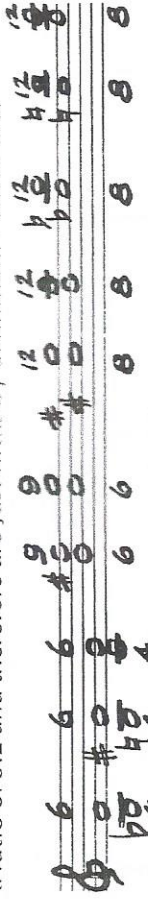
It is important when matching pitches with two different fingerings to compensate for the difference in resistance of the two tube lengths by altering the pitch when the resistance changes. The best way to do this is to play a steady tone and change the fingering back and forth about once a second. Using this approach, any discrepancy between the

resulting pitches will be due to the tube length and not tube resistance. When the experienced horn player tries this tuning he will no doubt find that in some ways it does not suit his needs. Its usefulness, however, lies in the fact that any horn player, regardless of experience, can tune his horn in a few minutes. If this is not sufficient reason for adopting this method, there is also ample acoustical justification for its use.

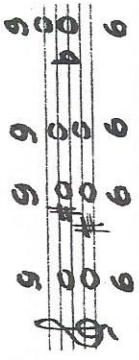
### ACOUSTICAL JUSTIFICATION

Despite the fact that wind instruments are basically tuned to Equal Temperament, harmonic intervals produced by these instruments are most satisfactory when tuned in Just Intonation. This is particularly true of the intervals of the fourth and fifth. Out of tune thirds and sixths do not produce beats nor do seconds and sevenths. Furthermore, because the fourth is the inversion of the fifth, it is not important in the determination of a tuning system.

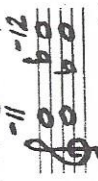
Within the range of the horn where tuning is critical, small g to c'', there are 23 fifths. (Below small g the notes are so flexible that the player must tune them with his ear.) Of those, 10 will be just fifths no matter how the instrument is tuned because they are played on harmonics which are at a ratio of 3:2 and therefore are just fifths by definition. These are:



In adjusting the valve slides as we have, four more fifths have been made just, since the valved notes now correspond to notes on the harmonic series which have a 3:2 ratio. These are:



Two other fifths are very close to just, only being off by the error created by the use of valves in pairs. These are:



The remaining fifths are those which contain notes which are normally taken on the fifth partial:



In relation to Equal Temperament the fifth partial is very low, fourteen cents below what it should be for the Equal Tempered scale. The fifths containing these notes are:

These fifths all suffer from the low fifth partial, those with the fifth partial notes on the top being too narrow, and those with the fifth partial on the bottom being too wide. These discrepancies are indicated in cents in the chart above. It can be seen that some of these fifths are no worse than the A-E and Ab-Eb fifths cited above. This is due to the fact that in these cases the discrepancies resulting from the use of valves partially compensate for the flatness of the fifth partial.

Out of the 23 fifths then, there are 14 Just fifths, five fairly close to being Just, with only four being quite far from Just intonation. Any attempt to correct the four out of tune fifths will, of course, result in disturbing the acceptable ones. One possible way of controlling the fifths which contain fifth partial notes would be to take these notes as sixth or fourth partials (using different fingerings).

Using the following fingerings it would be possible to produce Just fifths in each case:<sup>3</sup>

For those who are not impressed by the justification of tuning by fifths, the relation of the Equal Tempered scale to the scale produced by this tuning system is shown below.<sup>4</sup>

In relation to Equal Temperament the compromise produced by this tuning method is quite acceptable except for those notes which are normally taken on the fifth partial.<sup>5</sup> A possible solution to the problem of these notes was mentioned above, but the fact remains that further adjustment of the valve slides will not change the flatness of the fifth partial notes. It will be necessary for the player to make substantial adjustments

of the pitch of these notes as he plays no matter what the position of the valve slides.

If one is willing to accept the necessity of raising the pitch of the partial notes and the principle of compromise necessary when the brass instrument, the tuning system proposed above becomes workable and extremely practical because of its ease of application.

- 1 This assumes, of course, that the partials produced on the horn agree exactly with the harmonic series.
- 2 Numbers indicate partials.
- 3 Circled numbers indicate Bb horn fingerings.
- 4 Numbers indicate cents above or below the Equal Tempered scale.
- 5 Because of this flatness, tuning on e' when playing in an orchestra be avoided. It would be much better to tune on e''.