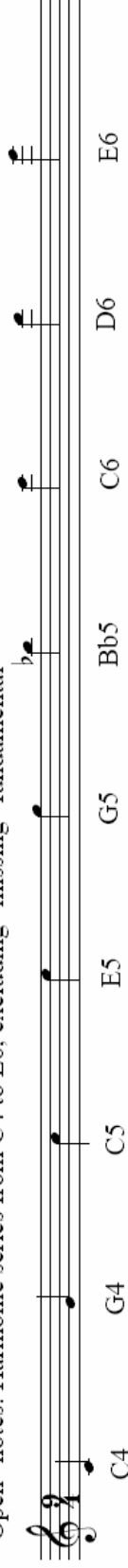


The Trumpet Harmonic Series

-Chromatic capability is enabled through use of valve combinations; each of which produces a progressively lower-pitched harmonic series-

Producing tones throughout the range of the trumpet is based on the ability to play different pitches using the same valve combinations. The first trumpets didn't have any valves, and could only play notes of the fixed harmonic series on their instrument. It was like playing only the open notes on a modern trumpet.

"Open" notes: Harmonic series from C4 to E6, excluding "missing" fundamental



A musical staff in treble clef showing the notes of the harmonic series for the open trumpet. The notes are: C4 (two ledger lines below), G4 (below staff), C5 (below staff), E5 (below staff), G5 (below staff), C6 (below staff), D6 (below staff), and E6 (below staff). Each note is marked with a 'f' for fortissimo.

Valves allow us to add lengths of tubing to the trumpet that lower the pitch by definite half-step intervals. As you can see on the harmonic series notated above, the interval size between successive harmonics becomes smaller as the pitch ascends. The largest of these intervals is at the low end: the six half-step interval between C4 and G4. Three valves are needed in combination to produce the six definite lengths of tubing that can play each of these chromatic half-steps. Each of these valve combinations also produces its own harmonic series:

Harmonic series for each valve combination



A musical staff showing six harmonic series for different valve combinations. The series are: 'open' (C4-G4), '1' (Bb4-F#4), '2' (Bb4-F#4), '12 (or 3)' (Bb4-F#4), '23' (Bb4-F#4), '13' (Bb4-F#4), and '123' (Bb4-F#4). Each series is shown as a sequence of notes with a 'f' marking.

Using these valve combinations in sequence starting on each "open" pitch, you can demonstrate how they function chromatically:



A musical staff showing a sequence of notes starting on C4 and moving chromatically down to Bb4. The notes are: C4, Bb4, Bb4, Bb4, Bb4, Bb4, Bb4, Bb4. The sequence of valve combinations is: O, 2, 1, 12, 23, 13, 123. Each note is marked with a 'f'.

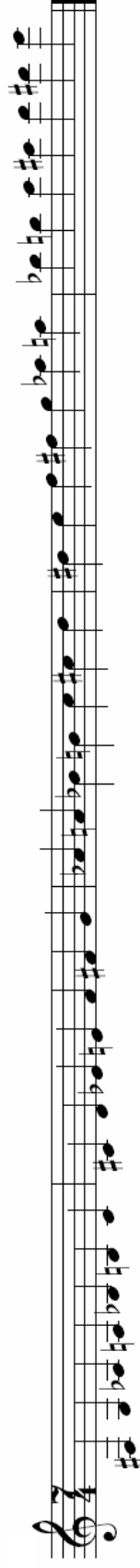
Note: measure 2 shows the 6 half-steps needed to bridge C4 to G4

Note: increased overlapping (alternate fingerings) as harmonics get closer together

Notice that in the upper register, the decreasing interval between successive harmonics results in the ability to play certain pitches with more than one valve combination. These are known as alternate fingerings. The chart on the next page summarizes which valve combinations can be used to produce each pitch.

Trumpet Pitches Produced by Valve Combination

| Valves: | F#3 | G3 | G#3 | A3 | A#3 | B3 | C4 | C#4 | D4 | D#4 | E4 | F4 | F#4 | G4 | G#4 | A4 | A#4 | B4 | C5 | C#5 | D5 | D#5 | E5 | F5 | F#5 | G5 | G#5 | A5 | A#5 | B5 | C6 | C#6 | D6 | D#6 | E6 |
|-----------|-----|----|-----|----|-----|----|----|-----|----|-----|----|----|-----|----|-----|----|-----|----|----|-----|----|-----|----|----|-----|----|-----|----|-----|----|----|-----|----|-----|----|
| 0 | | | | | | | X | | | | | | X | | | | | | | | | | | | | X | | | | | | | | | X |
| 2 | | | | | | X | | | | | | | X | | | | | | | | | | | | | X | | | | | | | | | X |
| 1 | | | | | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | X |
| 12 (or 3) | | | | | | X | | | | | X | | | | | | | | | | | | | | | X | | | | | | | | | X |
| 23 | | | | | | | | | | | X | | | | | | | | | | | | | | | X | | | | | | | | | X |
| 13 | | | | | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | X |
| 123 | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | X |



Pink Shading = Note is significantly out of tune

Note: Pitch intonation in the upper register may vary significantly by instrument, mouthpiece, and performer tendencies