

Marc Sabat

HAIRY HIPPIY HAPPY

*music for 39 distinct trombone slide positions dividing the perfect fourth in one to fifteen
equidistant parts in alternating directions set in rondo form
with freely composed horn and tuba pitches
chosen from various overtone series*

for double horn, tenorbass trombone and 5-valve F-tuba

PLAINSOUND MUSIC EDITION

HAIRY HIPPY HAPPY (2006/2010)

brass music for Trio Kobayashi, Los Angeles

music for 39 distinct trombone slide positions dividing the perfect fourth in one to fifteen equidistant parts in alternating directions set in rondo form with freely composed horn and tuba pitches chosen from various overtone series to form chords of tuneable intervals

This piece continues an ongoing series of works for brass instruments tuned in Just Intonation begun in 2005 with the work "Wonderful Scatter", composed for 6-valve F Tuba and computer and premiered by Robin Hayward. It is a revised version of a piece originally composed at Hayward's request for the trio Zinc and Copper Works, Berlin. The horn and tuba valve-slides are tuned in rational proportions, allowing the various combinations to be considered as part of an extended Just Intonation lattice. The tenorbass trombone joins the utonally-related harmonic series of the two valved instruments by considering various divisions of its slide into equidistant parts. The conception of these pieces came from examining the relationship between the two sides of trombone, suggested in a conversation with Wolfgang von Schweinitz in 2006. I imagine the counterpoint of structures based on tuneable intervals as a sequence of 'consonances' in the most generalized sense, as sonorities which may be precisely determined by ear.

The choice of melodic path between adjacent trombone slide positions is made to minimize harmonic distance ('way of least resistance') and generates friction with the complexity of the utonal pitch relationships presented by the slide divisions. The trombone's melody is accompanied by composed pitches from various overtone series, based on the principle that in three-part structures two of the three intervals ought to be tuneable by ear. This rule is usually followed. In both pieces, the loudness of pitches is often inversely proportional to duration, and should be evenly matched between all three instruments to maximize the particular interference qualities of the intervals and chords.

The rhythm is notated as a sequence of shared and solo events against a common ictus, which may vary as precise tuning demands. The feeling of the quick passages might resemble a dancing bearish fellow, who then once again comes to rest in an odd pose. Generally, there might be a preference for even calmness in the tone, emphasizing at all times the resonances and beatings of the harmonies themselves.

The various titles are a fond nod to California, Satie and La Monte.

An informal introduction to the Helmholtz-Ellis Accidentals

by Marc Sabat

Berlin, April 2009

In learning to read HE accidentals, without having to rely on an electronic tuning device, it is important to be familiar with three things:

First, to keep in mind the natural tuning of intervals in a harmonic series, which deviate from the tempered system.

Second, to get to know how the accidentals refer to these overtone relationships.

Third, to observe that each written pitch may be related to many other pitches by natural intervals, and to tune it accordingly.

In most cases, this approach will allow the player to quickly and intuitively play just intonation (JI) pitches quite accurately. Any remaining adjustments can be made by ear, based on the specific sound of JI intervals.

Just intervals are readily learned because they are built up from simple, tuneable harmonic relationships. These are generally based on eliminating beating between common partials, finding common fundamentals and audible combination tones, and establishing a resonant, stable sonority which maximizes clarity: both of consonance and of dissonance.

A well-focussed JI sound is completely distinct from the irregular, fuzzy beating of tempered sounds. Just consonances, when marginally out of tune, beat slowly and sweetly and may be corrected with the most subtle adjustments of bowing or breath. Just dissonances produce a sharply pulsing regular rhythm and have very clear, distinct colors.

To become familiar with the notation and sounds of JI, the fundamental building blocks are prime number overtones 3, 5, 7, 11 and 13, each of which is associated with a specific pair of accidentals and a basic musical interval.

3 is associated with the signs flat, natural, sharp and refers to the series of untempered perfect fifths (Pythagorean intonation). Generally, A is taken as the tuning reference, and the central pitches C-G-D-A-E can be imagined as the normal tuning of the orchestral string instruments. The just C is rather lower than tempered tuning because of the pure fifths. The further this series is extended, the greater the deviation from tempered tuning: the flats are lower, the sharps higher.

5 is associated with arrows attached to the flat, natural, sharp signs and refers to the pure major third. These arrows correct the Pythagorean intervals by a Syntonic Comma, which is approximately $\frac{1}{9}$ of a whole tone or 22 cents. So, for example, the note E-flat arrow-up is a just major third below G, and the note F-sharp arrow-down is a major third above D. In most music, flats are often raised by a comma and sharps are lowered. Because of the open string tuning, it is common to sometimes raise F and C (to match A and E) and to sometimes lower A and E (to match F and C). Corrections by one Syntonic Comma have been used throughout Western music history and are relatively familiar to the ear. However, traditionally these corrections have been hidden by players, for example in Meantone Temperament where fifths are mistuned narrow by $\frac{1}{4}$ comma so that the third C-E ends up sounding pure. More recently, the currently prevailing Equal Temperament has made us accustomed to beating thirds, so at first the pure intervals may seem unfamiliar. To play the arrows accurately, one must carefully learn the sound of the consonant major and minor thirds and sixths, and learn to articulate comma differences clearly.

7 is associated with a Tartini sign resembling the numeral. It corrects the Pythagorean intervals by a Septimal Comma, which is approximately $\frac{1}{7}$ of a whole tone or 27 cents. When the Pythagorean minor third is lowered by this amount, it becomes a noticeably low third often heard in Blues music.

11 is associated with the quartertone signs (cross and backwards flat). The accidental is used to raise the perfect fourth by 53 cents, producing the exact tuning of the 11th partial in a harmonic series. The sound is most easily learned by playing one octave plus one fourth and raising it by a quartertone.

13 is associated with the thirddtone signs (cross and backwards flat, each with 2 verticals). The accidental is used to lower the Pythagorean major sixth by 65 cents, producing the exact tuning of the 13th partial in a harmonic series. The sound is most easily learned as a neutral-sounding sixth, one-third of the way between the just minor and just major sixths (closer to minor than to major).

The following table presents the accidentals together with their associated ratios and cents deviations. To calculate the cents deviation from Equal Temperament of a specific written pitch (if desired) the following shortcut may be used:

- 1.) Find the cents deviation of the Pythagorean pitch, by calculating how many fifths it is away from A, multiplying by 2, and using a plus sign if it is on the sharp side and a minus if it is on the flat side.
- 2.) For each microtonal accidental, add or subtract its approximate cents value (as given above), keeping in mind whether the accidental is raising or lowering the pitch.

The resulting value should be a cents deviation within 1 or 2 cents accuracy, which is an acceptable starting point for fine-tuning by ear.

ACCIDENTALS

EXTENDED HELMHOLTZ-ELLIS JI PITCH NOTATION

for Just Intonation

designed by Marc Sabat and Wolfgang von Schweinitz

The exact intonation of each pitch may be written out by means of the following harmonically-defined signs:

$\flat\flat$ \flat \natural \sharp \times *Pythagorean series of fifths – the open strings*
(... c g d a e ...)

\flat \natural \sharp \times $\flat\flat$ \flat \natural \sharp
lowers / raises by a syntonic comma
 $81 : 80 = \text{circa } 21.5 \text{ cents}$

\flat \natural \sharp \times $\flat\flat$ \flat \natural \sharp
lowers / raises by two syntonic commas
circa 43 cents

\lrcorner \llcorner
lowers / raises by a septimal comma
 $64 : 63 = \text{circa } 27.3 \text{ cents}$

\llcorner \lrcorner
lowers / raises by two septimal commas
circa 54.5 cents

\dagger \dagger
raises / lowers by an 11-limit undecimal quarter-tone
 $33 : 32 = \text{circa } 53.3 \text{ cents}$

$\#$ $\#$
lowers / raises by a 13-limit tridecimal third-tone
 $27 : 26 = \text{circa } 65.3 \text{ cents}$

\approx \approx
lowers / raises by a 17-limit schisma
 $256 : 255 = \text{circa } 6.8 \text{ cents}$

\nearrow \searrow
raises / lowers by a 19-limit schisma
 $513 : 512 = \text{circa } 3.4 \text{ cents}$

\uparrow \downarrow
raises / lowers by a 23-limit comma
 $736 : 729 = \text{circa } 16.5 \text{ cents}$

In addition to the harmonic definition of a pitch by means of its accidentals, it is also possible to indicate its absolute pitch-height as a cents-deviation from the respectively indicated chromatic pitch in the 12-tone system of Equal Temperament.

The attached arrows for alteration by a syntonic comma are transcriptions of the notation that Hermann von Helmholtz used in his book “Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik” (1863). The annotated English translation “On the Sensations of Tone as a Physiological Basis for the Theory of Music” (1875/1885) is by Alexander J. Ellis, who refined the definition of pitch within the 12-tone system of Equal Temperament by introducing a division of the octave into 1200 cents. The sign for a septimal comma was devised by Giuseppe Tartini (1692-1770) – the composer, violinist and researcher who first studied the production of difference tones by means of double stops.

VORZEICHEN

EXTENDED HELMHOLTZ-ELLIS JI PITCH NOTATION

für die natürliche Stimmung

konzipiert von Marc Sabat und Wolfgang von Schweinitz

Die Stimmung jedes Tons ist mit folgenden harmonisch definierten Vorzeichen ausnotiert:

$\flat\flat$ \flat \natural \sharp \times

Pythagoreische Quintenreihe der leeren Streicher-Saiten
(... c g d a e ...)

\flat \natural \sharp \times $\flat\flat$ \flat \natural \sharp

Erniedrigung / Erhöhung um ein Syntonisches Terzkomma
 $81 : 80 = \text{circa } 21.5 \text{ cents}$

\flat \natural \sharp \times $\flat\flat$ \flat \natural \sharp

Erniedrigung / Erhöhung um zwei Syntonische Terzkommas
 $\text{circa } 43 \text{ cents}$

\lrcorner \llcorner

Erniedrigung / Erhöhung um ein Septimenkomma
 $64 : 63 = \text{circa } 27.3 \text{ cents}$

\llcorner \lrcorner

Erniedrigung / Erhöhung um zwei Septimenkommas
 $\text{circa } 54.5 \text{ cents}$

\dagger \dagger

Erhöhung / Erniedrigung um den undezimalen Viertelton der 11er-Relation
 $33 : 32 = \text{circa } 53.3 \text{ cents}$

\mathbb{H} \mathbb{H}

Erniedrigung / Erhöhung um den tridezimalen Drittelton der 13er-Relation
 $27 : 26 = \text{circa } 65.3 \text{ cents}$

\approx \approx

Erniedrigung / Erhöhung um ein Siebzehner-Schisma
 $256 : 255 = \text{circa } 6.8 \text{ cents}$

\nearrow \searrow

Erhöhung / Erniedrigung um ein Neunzehner-Schisma
 $513 : 512 = \text{circa } 3.4 \text{ cents}$

\uparrow \downarrow

Erhöhung / Erniedrigung um ein Dreiundzwanziger-Komma
 $736 : 729 = \text{circa } 16.5 \text{ cents}$

Zusätzlich zu der harmonischen Definition der Tonhöhe durch das Vorzeichen für jeden Ton ist auch der Cents-Wert der Abweichung der gewünschten Stimmung von der Tonhöhe des jeweils bezeichneten chromatischen Tons der gleichstufig temperierten Zwölfton-Skala angegeben.

Die attachierten Pfeile für die Alteration um ein Syntonisches Terzkomma sind eine bloße Transkription der Notation, die Hermann von Helmholtz in seinem Buch "Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik" (1863) verwendet hat. Die kommentierte englische Übersetzung "On the Sensations of Tone as a Physiological Basis for the Theory of Music" (1875/1885) stammt von Alexander J. Ellis, der auch eine enorme Verfeinerung der Tonhöhendefinition innerhalb des Zwölftonsystems der gleichstufig temperierten Stimmung durch die Unterteilung der Oktave in 1200 Cents eingeführt hat. – Das Vorzeichen für die Alteration um ein Septimenkomma wurde von Giuseppe Tartini (1692-1770) erfunden, der als Komponist, Geiger und Wissenschaftler die durch Doppelgriffe erzeugten Differenztöne untersucht hat.

JI Tuning for double horn, F-tuba with 5 valves, and tenorbass trombone

HORN: The valve slides 1, 2, and 3 are tuned to the rational proportions $2/15$, $1/15$, and $3/15$ of the open horn's length (both in B-flat and F), producing, in various combinations, two related utonal chromatic series of fundamental pitches with vibrational time periods in the proportions 15 : 16 : 17 : 18 : 19 : 20 : 21.

F-TUBA: The valve slides 1, 2, 3, 4, and 5 are tuned to the rational proportions $2/15$, $1/15$, $3/15 = 1/5$, $5/30 = 1/6$ of the open horn's length, producing, in various combinations, a utonal micro-chromatic series of fundamental pitches with vibrational time periods in the proportions 30:32:34:35:36:37:38:39:40:41:42:43:44:45:46:47:48:49:50:51:52:53:55:57.

TENORBASS-TROMBONE: The trigger slide is tuned to produce a perfect fourth in slide between comma-raised B-flat (a pure major third below the cello's D-string) and comma-raised F (a major tenth below the cello's A-string)

The musical score is organized into three main sections: Horn (F), Trombone, and Tuba. Each section contains two staves, one for the instrument's fundamental pitch and one for its vibrational time periods.

- Horn (F):** The top staff shows the fundamental pitch in F major (F4, G4, A4, Bb4, C5, D5, Eb5, F5). The bottom staff shows vibrational time periods in the ratios: 15, 16, 17, 18, 19, 20, 21.
- Trombone:** The top staff shows the fundamental pitch in B-flat major (Bb3, C4, D4, Eb4, F4, G4, Ab4, Bb4). The bottom staff shows vibrational time periods in the ratios: 30, 32, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 55, 57.
- Tuba:** The top staff shows the fundamental pitch in F major (F2, G2, A2, Bb2, C3, D3, Eb3, F3). The bottom staff shows vibrational time periods in the ratios: 15, 16, 17, 18, 19, 20, 21.

Additional tuning information is provided for the Trombone section:

- Tenor:** Ratios 7/10, 7/9, 7/8, 27/15, 3/24, 1/5, 2/9, 1/4, 4/15, 3/10, 1/3, 5/12, 4/9, 7/15, 1/2, 8/15, 5/9, 7/12, 2/3, 17/15, 5/4, 7/9, 4/5, 5/8, 7/8, 9/10, 11/12, 14/15, 17/1.
- Trombone:** Ratios 7/10, 7/9, 7/8, 27/15, 3/24, 1/5, 2/9, 1/4, 4/15, 3/10, 1/3, 5/12, 4/9, 7/15, 1/2, 8/15, 5/9, 7/12, 2/3, 17/15, 5/4, 7/9, 4/5, 5/8, 7/8, 9/10, 11/12, 14/15, 17/1.
- Bass:** Ratios 7/10, 7/9, 7/8, 27/15, 3/24, 1/5, 2/9, 1/4, 4/15, 3/10, 1/3, 5/12, 4/9, 7/15, 1/2, 8/15, 5/9, 7/12, 2/3, 17/15, 5/4, 7/9, 4/5, 5/8, 7/8, 9/10, 11/12, 14/15, 17/1.

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Marc Sabat

1 Tempo and rhythms a piacere, ictus ca. 52-66, take time as precise tuning requires

Horn (F)

Tenor-Bass Trombone

F Tuba (5 Valve)

0/1 (0 cm) = pos. F 0.86 pos. Bb 0.88 *

dynamics are to be very evenly matched, and interpreted as variations of loudness only: the music should remain calm and cool at all times, even when marked **ff** cresc. and dim. only where indicated, otherwise a soft "subito" change

* trombone positions are given in relation to the 'tempered' positions using decimals to indicate 1/100ths of a semitone, i.e. 'cents'; measure in cm may vary between instruments

shared time points are indicated in all playing voices by either a stemless notehead or comma; pitches connected by a beam are not to be re-articulated, but rather should be treated as tied notes; a tenuto line refers to an evenly sustained duration, never a re-attack or stress; notes in immediate succession may be connected or slightly separated ad lib., unless slurred legato is explicitly notated; solo events are written using smaller stemmed notes; generally, ensemble may be approached with varying degrees of focus — the timing of certain events may be very precisely coordinated whilst at other places, the score might be interpreted somewhat more freely as 'space-time notation'

2

Hn. (F)

Tbn.

Tba.

1/1 (48 cm) = 2/2 pos. Bb 5.86 pos. F 4.73

lower pitches circa 25¢ by hand-stopping (melodic interval 26 : 21)

beating! @ ca. 3 Hz against trombone

± : lip the natural partial by 3-8¢
≈ : pitch lies within 3¢

3

Hn. (F)

Tbn.

Tba.

1/2 (24 cm) = pos. Bb 3.55 pos. F 2.90

7

61

Hn. (F)

3/3 (48 cm) = 4/4
pos. Bb 5.86
pos. F 4.73

Tbn.

Tba.

beating! horn against trombone

mf ff p pp mf

mf ff p (senza cresc.)

8

71

Hn. (F)

3/4 (36 cm) =
pos. Bb 4.75
pos. F 3.84

Tbn.

Tba.

beating! with horn

beating! with horn

p (senza cresc.) f pp p pp (senza cresc.)

p (senza cresc.) f p pp

9

81

Hn. (F)

2/4 (24 cm) = 1/2
pos. Bb 3.55
pos. F 2.90

Tbn.

Tba.

legato

p mp pp

p (senza cresc.) pp

10

91

Hn. (F)

Tbn.

Tba.

$1/4$ (12 cm) = pos. Bb 2.27 pos. F 1.91

+14 (12)

+16 (9)

+12 (8)

-19

p *mp* *mf* *ff* *p* *mf*

+14 (13b)

+73 (4b)

+18 (6)

+73 (9+)

+45 (11-)

p *mp* *ff* *p* *mf*

mp *mf* *ff* *p* *mf*

11

101

Hn. (F)

Tbn.

Tba.

$0/4$ (0 cm) = $0/5$ pos. F 0.86 pos. Bb 0.88

+12 (4b)

+16 (3)

-19

mp *p* *mp*

mf *mp* *mp*

+14 (4)

+29 (4)

mf *mp* *p* *mp*

12

111

Hn. (F)

Tbn.

Tba.

$1/5$ (9.6 cm) = pos. Bb 2.00 pos. F 1.71

+16

+2 (2)

+2 (12b)

-2

+29

-49

+2 (8)

mf *p* *mp* *pp* *pp*

mf *p* *mp* *pp*

mf *p* *mp* *pp*

beating! with horn

legato!

13

bend down
by 5¢

2/5 (19.2 cm) =
pos. F 2.51
pos. Bb 3.05

121

Hn. (F)

Tbn.

Tba.

ff f mf ff mf <f> mf f ff ff mf f f ff mf f f

ff f ff mf ff f mf ff mp mf f f

ff f mf mf f mf <f> mf ff mf ff mp mf f f

14

3/5 (28.8 cm) =
pos. Bb 4.04
pos. F 3.28

131

Hn. (F)

Tbn.

Tba.

mp pp p

mp pp p

>mp p

15

4/5 (38.4 cm) =
pos. F 4.02
pos. Bb 4.98

141

Hn. (F)

Tbn.

Tba.

pp mp p

pp mp p

pp mp

16

151

Hn. (F)

Tbn.

Tba.

$5/5 (48 \text{ cm}) = 6/6$
pos. Bb 5.86
pos. F 4.73

beating! horn against trombone

p *mp* *mf* *ff* *p* *pp* *mf*

5b, 8, 7, 6b, 8f, 12b, 3, 59, 5, 75, 7+

+14, +44, +77

mf *ff* *p* (senza cresc.)

17

161

Hn. (F)

Tbn.

Tba.

$5/6 (40 \text{ cm}) =$
pos. Bb 5.13

bend down by 10¢

beating! tuba against trombone

mf *p* *mp* *mp* *p*

7b, 2b, 3b, 4b, 6b, 7b, 11, 7, 11

-16, -26, -13, -11, -25, -26, -24, -40, -57

p *mp* *mf* *mp* *p*

18

171

Hn. (F)

Tbn.

Tba.

$4/6 (32 \text{ cm}) = 2/3$
pos. Bb 4.36
pos. F 3.53

bend up by 5¢

mf *f* *ff* *mp* *ff* *f* *mf* *f* *mf* *mf* *f* *mf* *mf* *mf* *f* *mf*

11b, 4b, 8f, 7f, 4f

+16, -36, +47, +14, +16, -17, -16

fff *f* *ff* *ff* *>f* *ff* *>f* *mf* *mp* *mf* *mf*

5, 3-, 4-, 6-, 8, 8, 7, 6

mf *f* *fff* *mp* *mf* *mf* *mp* *mf*

19

181

Hn. (F)

Tbn.

Tba.

$\frac{3}{6}$ (24 cm) = $\frac{1}{2}$
pos. Bb 3.55
pos. F 2.90

mp beating! horn against trombone

pp

mp p pp

14 beating! tuba against trombone match horn

mp pp

20

191

Hn. (F)

Tbn.

Tba.

$\frac{2}{6}$ (16 cm) = $\frac{1}{3}$
pos. F 2.25
pos. Bb 2.71

mf

f mf f ff mp mf f

ff

mf mp mf f mf f ff mf f

mf f ff mp mf f

ff mf

21

201

Hn. (F)

Tbn.

Tba.

$\frac{1}{6}$ (8 cm) =
pos. F 1.57
pos. Bb 1.82

ppp

ppp

ppp

22

211

Hn. (F) $+14$ $+16$ $+18$

Tbn. $+12b$ $+16$ $9b$

Tba. -4 $+29$ 4

$0/6$ (0 cm) = $0/8$
pos. F 0.86
pos. Bb 0.88

mp *p* *mp*

23

221

Hn. (F) $+4$ $+14$

Tbn. $+12$

Tba. $+10$ 8 -2

$1/8$ (6 cm) =
pos. F 1.40
pos. Bb 1.59

pp (senza cresc.) *p* *mp*

pp *p* *mp*

pp *p* (senza cresc.) *mp*

24

231

Hn. (F) $+14$ $+16$ $+12$ -19

Tbn. $+14$ $+73$ $13b$

Tba. $+18$ $+73$ 45

$2/8$ (12 cm) = $1/4$
pos. Bb 2.27
pos. F 1.91

p *mp* *mf* *ff* *p* *mf*

p *mp* *ff* *p* *mf*

mp *mf* *ff* *p* *mf*

25

241

Hn. (F)

3/8 (18 cm) =
pos. Bb 2.92
pos. F 2.41

8 7

+14 -17

beating! horn
and trombone

5- 4

-19 p

pp

Tbn.

+12 (9b)

p

+10 (6b)

mp p

+45 (5f)

pp

Tba.

11

+45 (7)

-21

p mp p pp

26

251

Hn. (F)

4/8 (24 cm) = 1/2
pos. Bb 3.55
pos. F 2.90

+14

mp

11-

-50

pp

Tbn.

+47 (3b)

mp > p

+10 (4f)

pp

Tba.

+45 (7)

+12 (4)

+14 (6)

mp p pp

27

261

Hn. (F)

5/8 (30 cm)

Tbn.

Tba.

28

271

Hn. (F) $6/8$ (36 cm) = $3/4$
pos. Bb 4.75
pos. F 3.84

Tbn.

Tba.

beating! with horn

beating! with horn

p *f* *pp* *p* *pp* *pp* *pp*

(senza cresc.)

(senza cresc.)

(senza cresc.)

29

281

Hn. (F) $7/8$ (42 cm) =
pos. F 4.29

Tbn.

Tba.

f *mf* *ff* *f* *ff* *mf* *f* *ff* *mf* *ff* *mf* *ff* *ff* *mf*

f *mf* *f* *mf* *ff* *f* *ff* *mf* *f* *ff* *ff* *ff* *ff* *mf*

f *mf* *f* *ff* *f* *mf* *f* *ff* *ff* *ff* *ff* *ff* *ff* *mf*

30

291

Hn. (F) $8/8$ (48 cm) = $9/9$
pos. F 4.73
pos. Bb 5.86

Tbn.

Tba.

beating! horn
against trombone

p *mp* *mf* *ff* *p* *pp* *mf*

p *mp* *mf* *mf* *ff* *p* *p* *mf*

mf *ff* *p* *p* *mf*

mf *ff* *p* *mf*

(senza cresc.)

31

301

Hn. (F) *mf* *mf mp* *ff*

Tbn. *mf* *mf mp* *p* *ff*

Tba. *mf* *mp* *mp*

8/9 (42.7 cm) =
pos. Bb 5.38
pos. F 4.34

32

311

Hn. (F) *p* *mp* *mf* *mf mp*

Tbn. *p* (senza cresc.) *mp* *mf* *mf mp*

Tba. *p* *mp* (senza cresc.) *p* *mp*

7/9 (37.3 cm) =
pos. Bb 4.87

33

321

Hn. (F) *mf* *f* *ff* *mp* *ff* *f* *mf* *f* *mf* *mf* *f* *mf* *mf*

Tbn. *fff* *f* *ff* *ff > f* *ff > f* *mf* *mp* *mf* *mf*

Tba. *mf* *f* *fff* *mp* *mf* *mf* *mf* *mf* *mp* *mf*

6/9 (32 cm) = 2/3
pos. Bb 4.36
pos. F 3.53

bend up by 5¢

34

331

Hn. (F) $\frac{5}{9}$ (26.7 cm) = pos. Bb 3.82

Tbn.

Tba.

p *mp* *p* *pp*

p *mp* *p* *pp*

35

341

Hn. (F) $\frac{4}{9}$ (21.3 cm) = pos. F 2.69

Tbn.

Tba.

mp *ff* *f* *mp* *mp* *mf* *mp* *mp* *mf*

mp *ff* *f* *mp* *mp* *mf* *ff* *mp* *mf*

mp *mp* *mf* *mp* *mf* *mp* *mf* *mp*

36

351

Hn. (F) $\frac{3}{9}$ (16 cm) = $\frac{1}{3}$ pos. F 2.25 pos. Bb 2.71

Tbn.

Tba.

f *mf* *f* *ff* *mp* *mf* *f* *ff* *mf*

mf *mp* *mf* *f* *mf* *f* *ff* *mf* *f* *ff* *mf*

mf *mf* *f* *mf* *f* *ff* *mp* *mf* *f* *ff* *mf*

37

361

Hn. (F)

2/9 (10.7 cm) = pos. F 1.80

Tbn.

Tba.

mf mf mp

mf p mp

mf p mp

38

371

Hn. (F)

1/9 (5.3 cm) = pos. Bb 1.51

Tbn.

Tba.

mp p p mf < f < ff

mp p p mf ff

mp p p mf f

39

381

Hn. (F)

0/9 (0 cm) = 0/10 pos. F 0.86 pos. Bb 0.88

Tbn.

Tba.

mp p p mp

mp mp mp mp

mp p mp

40

391

Hn. (F)

1/10 (4.8 cm)

Tbn.

Tba.

41

401

2/10 (9.6 cm) = 1/5
pos. Bb 2.00
pos. F 1.71

Hn. (F)

Tbn.

Tba.

mf pp

p mf pp

pp

pp

pp

42

411

3/10 (14.4 cm) =
pos. Bb 2.53

Hn. (F)

Tbn.

Tba.

pp

pp

pp

43

bend down
by 5¢

421

Hn. (F)

Tbn.

Tba.

ff *f* *mf* *ff* *f* *mf* *f* *ff* *ff* *mf* *f* *f*

ff *f* *f* *mf* *ff* *f* *mf* *ff* *mp* *mf* *f* *f*

ff *f* *mf* *mf* *mf* *f* *ff* *mf* *ff* *mp* *mf* *f* *f*

4/10 (19.2 cm) = 2/5
pos. F 2.51
pos. Bb 3.05

33 3 8 6 7 9 8 12 10

4 109 31 111 49 82 47 5 9 7 7 5 9 3 7 8

-4 -109 -31 -111 -49 -82 -47 -5 -33 -16 -1 -36 -2

11f 6f 13f 7f 9f 11f 4b 2b 11f

8 5 9 7 5 9 3 7 8

-63 -45 -81 -33 -16 -1

44

431

Hn. (F)

Tbn.

Tba.

ff *pp*

p *pp*

p *pp*

5/10 (24 cm) = 1/2
pos. Bb 3.55
pos. F 2.90

14 7b 10f 4

29 4

-2

p *pp*

45

441

Hn. (F)

Tbn.

Tba.

mp *pp* *p*

mp *pp* *p*

mp *p*

6/10 (28.8 cm) = 3/5
pos. Bb 4.04
pos. F 3.28

5 3 12b 9b 2

16 3

-16

mp *pp* *p*

-2

mp *p*

46

451

Hn. (F)

7/10 (33.6 cm)

Tbn.

Tba.

47

461

Hn. (F)

8/10 (38.4 cm) = 4/5
pos. F 4.02
pos. Bb 4.98

Tbn.

Tba.

48

471

Hn. (F)

9/10 (43.2 cm) =
pos. Bb 5.42
pos. F 4.38

Tbn.

Tba.

49

481

Hn. (F)

Tbn.

Tba.

10/10 (48 cm) = 12/12 pos. Bb 5.86 pos. F 4.73

beating! horn against trombone

beating! tuba against trombone

p *mp* *mf* *ff* *p* *pp* *mf*

p *mp* *mf* *mf* *ff* *p* *p* *mf*

mf *ff* *p* (*senza cresc.*)

50

491

Hn. (F)

Tbn.

Tba.

11/12 (44 cm)

51

501

Hn. (F)

Tbn.

Tba.

10/12 (40 cm) = 5/6 pos. Bb 5.13

bend down by 10c

beating! tuba against trombone

mf *p* *mp* *mp* *p*

p *mf* *mp* *p*

p *mp* *mf* *mp* *p*

52

511

Hn. (F) $\frac{9}{12}$ (36 cm) = $\frac{3}{4}$
pos. Bb 4.75
pos. F 3.84

Tbn. $\frac{9b$ $\frac{3f$ $\frac{5b$

Tba. $\frac{2+}{+64}$ $\frac{4+}{}$ $\frac{4}{+4}$ $\frac{5-}{-21}$ $\frac{5-}{+43}$

p *f* *pp* *p*

p (senza cresc.) *f* *p* *pp* (senza cresc.)

beating! with horn

beating! with horn

p (senza cresc.) *f* *p* *pp*

53

521

Hn. (F) $\frac{8}{12}$ (32 cm) = $\frac{2}{3}$
pos. Bb 4.36
pos. F 3.53

Tbn. $\frac{11b$ $\frac{4b$ $\frac{8f$ $\frac{7f$ $\frac{8f$ $\frac{7f$

Tba. $\frac{5}{+2}$ $\frac{3-}{-5}$ $\frac{4-}{}$ $\frac{6-}{-3}$ $\frac{6}{}$ $\frac{8}{+14}$ $\frac{8}{+16}$ $\frac{7}{}$ $\frac{6}{+49}$ $\frac{6}{-16}$

mf *f* *ff* *mp* *ff* *f* *mf* *f* *mf* *mf* *f* *mf* *mf* *f* *mf* *mf*

fff *f* *ff* *ff* *>f* *ff* *>f* *mf* *mp* *mf* *mf*

mf *f* *fff* *mp* *mf* *mf* *mf* *mf* *mp* *mf*

bend up by 5c

54

531

Hn. (F) $\frac{7}{12}$ (28 cm) =
pos. F 3.22

Tbn. $\frac{10f$ $\frac{8f$ $\frac{9f$ $\frac{10f$ $\frac{11f$

Tba. $\frac{10+}{}$ $\frac{12}{}$

mp *mf* *mp* *mf* *f* *mp* *mp* *ff* *mp*

mp *mf* *mf* *<f* *mp* *mp* *ff* *mp*

mf *mp* *mf* *f* *mf* *mp*

55

541

Hn. (F)

6/12 (24 cm) = 1/2
pos. Bb 3.55
pos. F 2.90

Tbn.

Tba.

11-
-50
-13 p
+14 (7b)
9f
7f
-21
+29 (4)
+12 (4)
p (senza cresc.)
pp

56

551

Hn. (F)

5/12 (20 cm)

Tbn.

Tba.

57

561

Hn. (F)

4/12 (16 cm) = 1/3
pos. F 2.25
pos. Bb 2.71

Tbn.

Tba.

11-
-50
mf
f
mf
f
ff
mp
mf
f
ff
mf
mf
+16 (6)
+77 (7+)
+14 (8)
+4
+16 (13f)
+79 (9f)
+5f
+9f
+44 (7f)
+31 (6b)
+10b
+12 (4)
+110 (3+)
+59
+44 (4)
+61 (3)
+6
+4
+8
+8+
-4
mf
mf
f
mf
f
ff
mp
mf
f
ff
mf

58

571

Hn. (F)

p *mp* *mf* *ff* *p* *mf*

3/12 (12 cm) = 1/4
pos. Bb 2.27
pos. F 1.91

+14 (12)

+16 (9)

+12 (8)

-19

Tbn.

p *mp* *ff* *p* *mf*

+14 (13b)

+73 (4b)

+45 (11-)

Tba.

+18 (6)

+73 (9+)

mp *mf* *ff* *p* *mf*

59

581

Hn. (F)

ppp

2/12 (8 cm) = 1/6
pos. F 1.57
pos. Bb 1.82

+29 (10f) beating! with horn

Tbn.

ppp

+16 (8)

Tba.

ppp

60

591

Hn. (F)

mp *TACET al fine*

0/12 (0 cm) =
pos. F 0.86
pos. Bb 0.88

+14 (12b)

Tbn.

mp

+16

Tba.

mp *TACET al fine*

mp

Meno mosso, a piacere, solo

slowly let out the slide, changing speed as gradually and continuously as possible to reach positions where indicated, all pitches approximate and always subtly sliding downward

61 $0/15 (0 \text{ cm}) =$
pos. F 0.86
pos. Bb 0.88

$1/15 (3.2 \text{ cm}) =$
pos. Bb 1.26

$2/15 (6.4 \text{ cm}) =$

Tbn. 601 $6b$ $4b$ $7b$?

sempre p - mp

$3/15 (9.6 \text{ cm}) = 1/5$
pos. Bb 2.00
pos. F 1.71

$4/15 (12.8 \text{ cm}) =$
pos. F 1.98
pos. Bb 2.36

Tbn. 611 $12b$ $9b$ $8f$ $7b$ $10b$

$5/15 (16 \text{ cm}) = 1/3$
pos. Bb 2.71
pos. F 2.25

$6/15 (19.2 \text{ cm}) = 2/5$
pos. F 2.51
pos. Bb 3.05

Tbn. 621 ? $13f$ $11f$

$7/15 (22.4 \text{ cm}) =$
pos. Bb 3.39

$8/15 (25.6 \text{ cm}) =$
pos. F 3.03

Tbn. 631 $13b$ $13b$ $7f$ $8f$

$9/15 (28.8 \text{ cm}) = 3/5$
pos. Bb 4.04
pos. F 3.28

$10/15 (32 \text{ cm}) = 2/3$
pos. F 3.53
pos. Bb 4.36

Tbn. 641 $12b$ $9b$ $7f$? $11b$ $10f$

$11/15 (35.2 \text{ cm}) =$
pos. Bb 4.67

$12/15 (38.4 \text{ cm}) = 4/5$
pos. F 4.02
pos. Bb 4.98

$13/15 (41.6 \text{ cm}) =$

Tbn. 651 $6b$ $7b$ $6f$? $8f$?

stop the slide

$14/15 (44.8 \text{ cm}) =$

$15/15 (48 \text{ cm}) = 1/1$
pos. Bb 5.86
pos. F 4.73

Tbn. 661 $10b$?