**On the Specification of a Bassoon**

Daniel Coble

The purpose of this document is to compile the measurement of a bassoon. The document pays special attention to the acoustic dimensions: the conical shape of bores and the location and shape of holes. Less attention is paid to the outer shape of the instrument, which is superficial [3]. Measurements have been taken from multiple instruments and are demonstrated to be compatible by the development of Open Bassoon design. All dimensions are marked with a superscript of the source instrument, i.e. 1, 2, 3, etc., and come from multiple manufacturers. See Appendix A for a list of all instruments. This document works towards the Open Bassoon design, the author’s naïve attempt to design an acoustically-sound instrument and publish the design with no copyright restrictions.

This paper is structured as follows. First, a brief description of the acoustic theory of the instrument is given. Next, sections are given to describe the bore and the instrument’s 30 holes. The paper then goes into detail on each of the five parts of the instrument: the bocal, tenor, boot, bass, bell. Finally, notes on the outer shape are given. All units are given in inches. Appendix B contains reproductions of each table with units in centimeters.

**Acoustic Theory of the Bassoon**

The idiosyncratic design of the bassoon is a result of its slow evolution into the modern form, where the trial-and-error approach to design has dominated over modern guided engineering. In fact, the bassoon design is so complicated that at this point computational methods have limited success, dooming further improvements (if there will ever be any) to more trial-and-error []. The fundamentals given below should be taken as a first-order approximations, where mostly true assumptions lead to mostly true conclusions.

**The Bore**

The bore is theoretically conical, though deviations from the perfect conical shape are important, perhaps the most important characteristic, in the tonal characteristics of an instrument. A great debt is given to [2], which meticulously measured the bore dimensions of some sixty-five, primary Heckel bassoons, as well as giving qualitative descriptions of each instruments tonal quality. Tables for selected instruments described as having good characteristics were digitized and are given below.

**The Holes**

Holes are numbered starting at the bell end going along the length of the instrument. In total, a modern bassoon has 29 or 30 holes (including the whisper key), with hole #\_ excluded in some designs. Five of them (#\_, #\_, #\_, #\_, and #\_) are directly closed by the finger, while the other keyholes are covered by pads which are mechanically connected to the fingered keys.

Tables for multiple bassoons are given below. Hole depths are given from the thinnest point (necessary to consider curvature). Fingered holes are also cut at angles to allow convenient fingering. Where given, the angle describes the angular cut into the bore: i.e. at the hole is cut straight down to the bore. If not given assume .

**The Bocal**

Though some useful information could be said about the bocal, its length and use in tuning, and interactions with the reed, the section here will be exceedingly brief. Although not truly a mouthpiece like other woodwind instruments, the bocal performs the same job of holding the reed and beginning the conical shape of the bore. Describing in detail the shape and acoustics of a bocal is mostly irrelevant since they are often chosen after a bassoon is manufactured, to provide the slight amount of tuning which the instrument allows. A typical bocal is \_\_ inches long, with an opening diameter of \_\_ inches and ending diameter of \_\_. The whisper key is located \_\_ inches along the length

**The Tenor**

**The Boot**

**The Bass**

The bass, or long joint, contains five holes, none of which are

**The Bell**

The bell is the simplest section of the instrument, having only a single hole located on the front of the part. It also has little relevance in all but the lowest notes, as for all high notes the acoustic length is much less than the length to the bell. Table [] gives all relevant details of the bell.

**The Outer Shape**

As was explained in the first section of the paper, there are many aspects of a bassoon which are acoustically irrelevant. These include the outer shape of the instrument and its material [4]. This certainly will disappoint some musicians, who view their instruments as a work of art. Not to fully dismiss them, certainly an instrument’s ergonomics is vital to its play, and having a visually beautiful instrument can give confidence to the performer, and enhance the experience of a concert-goer [5]. Below a partial description of the instrument’s outer shape is given. By virtue of its complex geometry, it is not possible to fully give a description here of the instrument’s shape.

**References and notes**

[1] George R. Plitnik, *The calculation of input impedance for double-reed wind instruments, and the time-variant analysis and synthesis of their tones, using digital computer techniques*. Doctoral Thesis (1972).

[2] James L. Burton, *Bassoon Bore Dimensions*. Doctoral Thesis (1975)

[3] Acoustical Aspects of Woodwind Instruments: Revised Edition, C.J. Nederveen (1998).

[4] At least Fox, and maybe some other manufacturers, go so far as to cut their maple trees during a certain time of the year, thinking it affects the tone. Maybe it does.

[5] This is an engineer’s way of giving concessions.

**Appendix A: Source Instruments**

1 Schreiber bassoon measured by George R. Plitnik and Byron Purves in [1].

2 Conn bassoon #3688 measured by the author.

3 Heckel bassoon measured by [3].

4 Riedl bassoon measured by [3].

5 Heckel bassoon #7071 measured by [2].

6 Heckel bassoon #8331 measured by [2].

7 Heckel bassoon #9280 measured by [2].

8 Heckel bassoon #9725 measured by [2].

9 Heckel bassoon #10307 measured by [2].

10 Open Bassoon design.

**Appendix B: Metric Tables**