A Quick Anatomy of the Flute

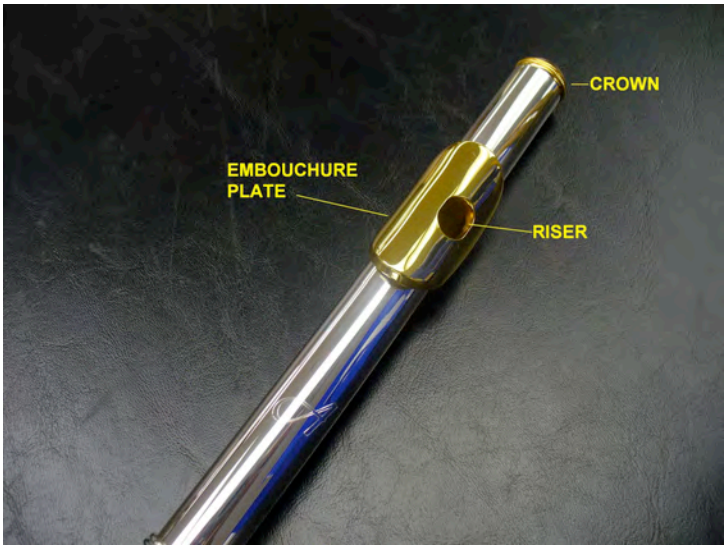
Here is a quick “dictionary” describing all of the parts of a flute and what their purposes are. Where possible, a photograph or drawing has been included. An index is located on pages 17 and 18.

The Headjoint and Its Parts

The headjoint is responsible for catching the vibrations that produce the sound of the flute. Some experts say that over 75% of the tonal quality of a flute is produced by the headjoint. Indeed, if the headjoint on a flute is replaced with another type of headjoint, the flute will sound entirely different. The headjoint tube can be tapered or conical. Most often it has a slight taper. The crown end is narrower than the end that fits into the flute body. Some craftsmen specialize in making only flute headjoints. One way to upgrade a student flute is to purchase a hand-carved headjoint. As stated above, it can improve the sound of the flute by as much as 75%.

Headjoint making is an art which is separate from flute making. Headjoints are often chosen to enhance qualities of a concert hall’s acoustics. Each manufacturer has its own signature style embouchure cut, and each pro headjoint maker seeks to create his or her own signature sound quality.

The headjoint is normally made of metal, usually silver-plated nickel for student flutes and precious metal for step up and pro flutes. Some flutists also prefer to use modern wooden headjoint to vary the color of their sound. The wooden headjoint does not hold up as well to extreme temperature changes. There is always a danger of developing cracks if not properly cared for.



Lip-Plate

A lip-plate's curve and angle differs with the design of every headjoint maker. The shape of the lip-plate determines the comfort level for the flutist, and to a certain extent the angle at which the air can be blown into the flute. Traditionally gently sloped, the modern lip plate has evolved into many different styles and shapes, featuring different slopes on the face-side and different angles and heights on the blowing-edge side. Some more extreme and contemporary lip-plates even feature portions of the lip-plate removed completely, with just the chimney being visible.

The material from which the lip plate is made does not affect the sound. It is the riser which has a direct affect on the sound and response.

Flutists with allergies to metals may prefer gold-plated or solid gold lip-plates.

Riser

The **riser** is the area on the inside of the lip-plate against which the air stream is directed. The riser also connects the lip-plate to the headjoint. The riser is sometimes also called a chimney. Differing chimney / riser heights can affect sound and articulation. A high riser produces more resistance and projection, but it is more difficult to control. A lower riser produces a sweeter sound and an easier dynamic range.

The material from which the riser is made can also affect the tonal quality and response of the flute. Silver, differing karats of gold, and platinum all feel, sound and respond differently to the flutist. Most listeners however, do not do not notice a significant difference. Scientific studies on this topic have proved to be non-conclusive.

Embouchure Cut

The embouchure cut is especially important. Every hand-cut embouchure is different and will feel different to the player. Just a slight scrape to remove metal or a change in angle can affect the response of the entire instrument. Headjoint makers strive to carve the headjoint to produce a perfect balance between the low and high registers. However, some players prefer to choose a heajoint which favors one register over another to benefit their particular strengths and weaknesses.

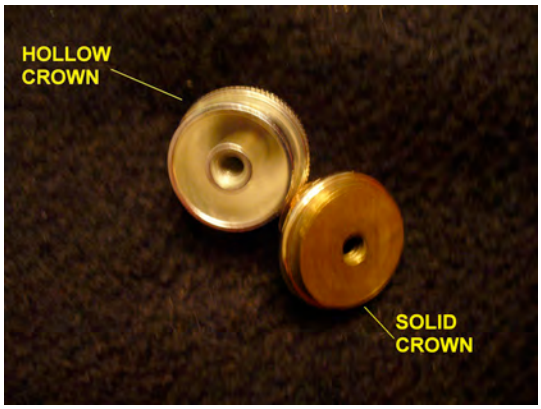
In general, a rectangular shape is louder, fuller and has a more projecting tone. An oval shape has more resistance and a sweet but smaller sound. There are a myriad of variations of these two extremes - enough to keep flutists searching for the perfect headjoint for their entire career.

Undercutting describes the cutting away and angling of the inside walls of the riser. Used in judicious amounts, undercutting creates more ease and flexibility in playing. However, too much undercutting produces a hiss in the sound as well as a limit to projection. It can also cause the 3rd octave to have intonation problems

Over cutting describes the rounding off of the side edges of the top surface of the embouchure hole. This makes it easier to place the air column. Too much over-cutting produces a tone without a strong center.

Crown

There are two main types of crowns, **molded** and **hollow** or **weighted** and **solid.** The weight of a crown can change the sound color and the response of a flute.



Crown Assembly or Headjoint Cork

Correct placement of the headjoint cork not only affects the pitch but also the response of the instrument. This area of the flute is often overlooked as a place to check for problems. Often, a stuffy low register or poor response of a flute is simply due to a cork that has started to leak or is not placed correctly in the headjoint. The cork should fit very tightly in the headjoint and the mirror smooth end plate should fit the curves and wall of the flute. The cork stopper should ***never*** be removed or pushed through the smaller, crown end of a conical headjoint.

Typical Cork Assembly

Alternate types of stoppers are now available which feature O-rings and synthetic materials that allow the space above the cork end to be hollow. This kind of stopper can open up the sound of a flute as well as potentially change the flute's response.

The Flute Body

The body is a **cylindrical extruded tube**. The first metal flutes were made from a flat piece of metal which was rolled and then **seamed**. Recently, there has been a revived interest in the seamed tube. Some players feel that the seam produces a different response and a wider range of tone color. From a scientific standpoint, the molecular structure of a seamed tube is not as warped or stretched as much as that of a drawn tube. The molecular structure of the metal stays more intact than on an extruded tube. However, seamed flute tubes are very time consuming and expensive to make. Because of this, most flute makers and players prefer the extruded body.

Tone Holes

Tone holes can either be **drawn and rolled** or **soldered**. Many flutists seem to notice no difference in the sound or the response between these two types of tone holes. However, others do notice slight differences. These differences include lighter vs. darker tone color and lighter vs. heavier amount of resistance. Thus the response of the flute can feel different as well as the weight of the flute. Soldering will always add weight. Soldered tone holes also increase the cost of the flute due to the labor involved in their manufacture. Soldered vs. drawn tone holes do not necessarily equate to quality. One can purchase a quality flute of either method of manufacture.

Rib Plate

This base plate is soldered onto the flute body. Then the posts are soldered onto the rib plate and this is the foundation that holds the mechanism. The width of the plate can change both tonal response and the stability of the mechanism.

Key Styles

There are two basic design styles of key work for the flute – **Y-arms** and **French pointed** key arms. Y- arms are generally forged (found in student or step-up flutes). Previously, Y-arms had the reputation of being unstable and easy to bend. However, today's forged keys possess very stable properties.

An Example of Y-Arm Design Keys

French pointed keys are found on step-up and professional flutes. The name is derived from the fact that the first quality metal flutes, which were produced in France, had this style of key arm. The French style of keys is actually made of several separate pieces which are hand-soldered to be one unit.

An Example of Pointed French Arm Keys

The opinion that the French key arm applies pressure directly to the center of the key while the Y Arm tends to apply pressure on the back of the key is not true. All keys start their motion from the arm. There is no benefit of one style over the other. ***It is simply a question of cosmetics rather than quality.***

Key Types

Plateau or "American" closed holed style G key cup

There are also two types of keys, **open hole,** also called **French, and plateau, closed hole,** or **American**. Today, most professional flutes are open holed and most student flutes are plateau. However, there is no reason why a beginner cannot start learning the instrument on an open holed flute, although some of the holes may have to be plugged if the fingers are small. Conversely, there are some professionals who prefer the closed holed flute.

"French" or open holed G key cup

Key mechanisms may be built with or without **adjusting screws**. Previously available only on student flutes, adjusting screws are now being found on some professional flutes, although many American makers still prefer not to use them. For the flutist, adjusting screws offer the opportunity to make minor pad adjustments which may become necessary due to climate change or wear. This may sometimes eliminate the need to make a trip to the repair shop

Top Mount Adjusting Screws

Bottom Mount or Hidden Adjusting Screws

Mechanism

Historically, the flute mechanism has been **pinned**. A steel shaft referred to as **the steel**, is placed in the hollow rod which holds the keys. The keys are then secured onto the rods with steel pins and to the posts with pivot screws. This provides a stable mechanism and it also allows certain paired keys to be joined in movement.

Today, other mechanisms sometimes replace all or parts of the pinned mechanism. A **pinless** mechanism uses socket head screws and bridge mechanisms instead of pins.

The **Broëgger Mekanik** has non-rotating shafts and fully sized back connecters for all the main line keys, as well as the ability to regulate spring tension on each key individually. It is also a very strong mechanism. These features result in a quiet flute with an even feel, and because it has reduced friction, potentially less wear is given to the moving parts. This mechanism is only found on professional level flutes.

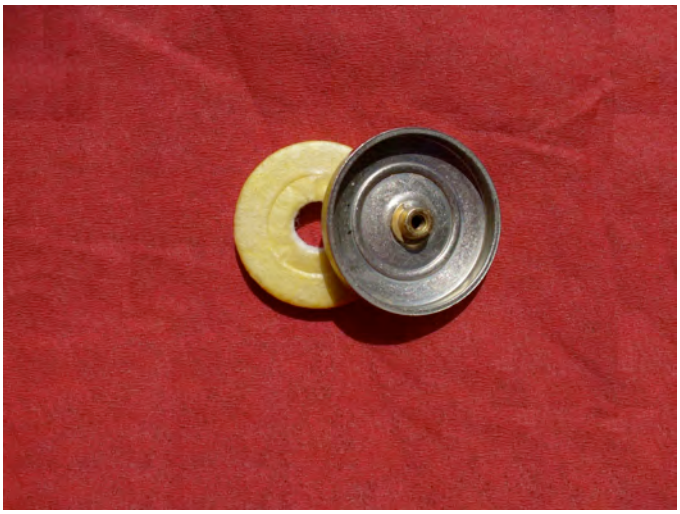
Springs

Needle **stainless steel** springs are the most commonly used springs for student flutes. Stainless steel springs offer superior holding power and they do not rust. Some flute companies also used alloyed springs. **Gold** springs have a lighter feel and are found on step-up and professional flutes. In addition to these, several spring alloys such as **silver-plated beryllium** are also available. A good spring should be able to be adjusted to any spring tension and it should have great holding power.

Needle springs on uncompleted footjoint.

Pads

Most pads are double skinned **bladder**. The felt portion of the pad comes in various degrees of hardness. It can either be **woven or pressed felt**. The pads can be purchased in different densities. Pressed pads are generally harder than woven pads. Student flutes usually have softer pads than pro flutes. A softer pad is easier to seat, but it also does not hold adjustment as well as a harder pad. The hardness or softness of a pad can also affect the tone color and response of a flute.



Example of Bladder Pad and stamped cup

Today, flutists have the luxury of purchasing synthetic pads instead of pads made of natural materials. Synthetic pads are more resistant to temperature and humidity changes than felt pads. The leader among synthetic pad makers is David **Straubinger** who has patented a skin covered **synthetic** pad that has proven to be superior to felt pads for most players. The majority of pro and step-up flute companies feature his pads on their flutes.

The Straubinger™ Flute Pad Assembly

Other commonly used synthetic pads are those by Schmidt and Valentino.

JS Gold Pad

Valentino Pads

The Flute Footjoint

C footjoint

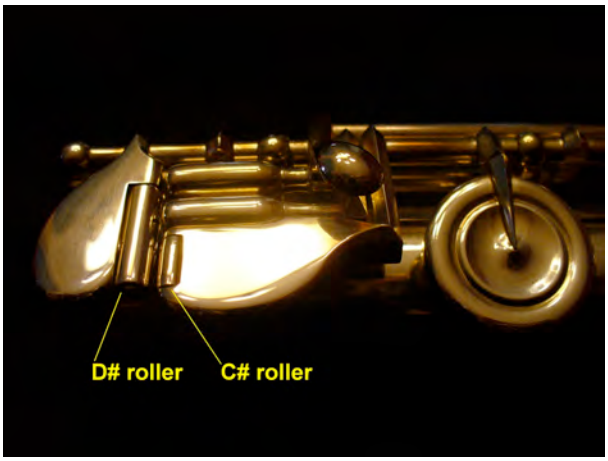
B footjoint

Originally, the flute's range extended only to D. The range of the flute was increased by the invention of the **C foot joint**. Most players used C footjoints until the early to mid 1900's when flutists, especially in the USA, preferred the **B footjoint**. The B footjoint not only allows the range to extend to a B below the staff, but it also changes the response, color, weight and balance of the flute. A C foot joint produces an easier upper register that has brilliance and projection. The B footjoint adds a darker color and provides the lower register with more richness and depth. Student flutes generally are made with a C footjoint, but it is not long before the student will want to purchase a step-up flute with a B footjoint.

There are three available key options for the footjoint; the **gizmo**,

Example of Gizmo Key

The **D# roller,** and the **C# roller**. The gizmo is a key located above the B roller key. This allows the flutist to easily reach the fingering for the fourth octave C. The **D# roller** is adjacent to the D sharp key. It enables a smoother transition and greater ease for fingering low D to C and C#. Not as commonly, the C# roller allows ease for transitioning from the C# to the D. However, if the footjoint keys are properly designed, with curved edges and proper placement these keys are not necessary. Many flutists prefer to have no additional roller keys installed.



Optional Flute Features

There are many optional features one flutes. Today, flutists can customize their flutes to their own preferences.

C# Trill – this is a separate rod which has a key cup located on the body next to the trill key cups. Its main function is to provide a good trill fingering between the third octave G and A. There are other uses as well. The C# trill can be used in the 1st and 2nd octaves as an aid for the C to C# trill and the B to C# trill. In the third octave it aids the trills of G to Ab, G to A, Ab to Bb, as well as a few tremolo fingerings –

In the first octave

- C# to G, Ab, A, Bb, B or C
- D from G, Ab, A ,Bb, or B
- D# from G, Ab, A, Bb, or B

In the second octave C# from A, Bb, or C

The disadvantage to the C# key mechanism is that it adds unwanted weight.

C# trill cup next to thumb key

C# trill lever placed next to Bb lever

Split E

The **split E** is a separate mechanism that aids in the production of the third octave E. This is its only function. On a closed G flute, the G is closed automatically when the E key is engaged. It is usually placed on an offset G mechanism, but it is also possible, though not recommended, on an inline G mechanism. The split E on the inline mechanism can sometimes cause binding problems if not machined perfectly.

G Donut or High E Facilitator

The **donut** is a small ring made either of synthetic material or metal that is glued or soldered into place in the G key tone hole. This covers the G tone hole slightly, allowing it to serve the same function as the split E. The only other note it affects is the third register A, which produces a slight reduction in tonal quality and usually a welcomed slightly flatter pitch.

G# Options

The G# key can either be **closed** when playing all other notes, (leaving the little finger of the left hand un-engaged for most fingerings) or **open** (depressed by the little finger for all other notes except G#). At the turn of the century there was a movement towards the closed G#, especially in the USA. Nevertheless, there are still players who prefer to use the open G# sharp. It is not easy for a player to convert from one or the other G configuration.

Reverse Thumb

The B and Bb thumb keys are reversed. This is an option rarely in use today.

Pitch

Traditionally, flutes were pitched at A=440. The trend in recent years is to purchase a flute at **A=442**. The standard pitch has been rising through the years and some countries choose to play as high as A=444. While most ensembles profess to play at A=440, the pitch often rises in the course of performance. This puts the flutist in a precarious position. It is not easy to raise the pitch on a flute once the headjoint is completely pushed into the body. However, with an A=442 flute, the flutist has more pitch variance at his or her disposal. This is very important in situations where the temperature is cold (the flute will be flat), where the flutist is playing with a high pitched un-tunable instrument such as piano or organ, or when playing with an orchestra or band whose pitch rises through a performance.

Engraving

Engraving is generally a cosmetic choice. The only place on the flute where it makes a true difference in playing is on the lip-plate. Engraving on the embouchure plate adds a little friction between the lip-plate and the chin. This helps to keep the flute in the proper playing position – a great aid especially if the flutist is sweating!

Example of Engraved Lip-Plate

Plating

Plating is used to cover nickel silver for a variety of reasons. The silver allows a better grip, cosmetically it looks like a solid silver flute, and there is no chance for a person allergic to nickel to have an allergic reaction. Plating over a silver tube also reduces production cost since less polishing is needed for a finished look.

Plating with other metals - gold or platinum, will change a flute's tone color – usually to the darker side, as well as giving it a slight change in response.

Plating a lip-plate creates no change in sound. Mostly used for cosmetic reasons, it will cure "flutist black chin" which is caused by a chemical reaction between the flutist's skin chemistry and metal or make-up and metal. It is also useful if the flutist has an allergic reaction to silver or nickel.

Tube Weight

Flute tubes come in different thicknesses. USA measurements are .012", .014", .016", and .018". This is referred to as **the wall thickness.** .016" is the standard USA wall thickness. Different wall thicknesses will produce different tone colors and projection qualities. Usually the heavier or thicker the wall, the darker the sound will be. Some flutists are better able to push the air column harder on a heavier or thicker wall which results in more projection. The effect of wall thickness on sound is different for every player. A heavier wall will also stand up to wear better than a thin wall tube. This is especially important when considering the purchase of student instruments.

Metals Alloys and Wood

There is great controversy on whether differing metals actually sound different. This is a much studied and discussed subject. For many listeners as well as flutists, there can be a distinct and noticeable tonal difference between flutes of differing metals when played by the same player. For most flutists, there is also a significant difference in the flute's response. However, to date there is no scientific data proving either to be true.

Metals used in flute making are usually Sterling Silver (.925% silver), coin silver (.900% silver or lower), Britannia silver (.958% silver), "pure silver" (usually .997% or .998 % silver content), gold (9K, 10K, 14K, 18K), platinum, and various

mixtures of all of the above whose formulas are usually proprietary to the flute company producing them.

There is currently a renewed interest in wooden flutes. Previously found only as antique instruments, they are now crafted with a modern embouchure cut, bore, scale, pitch, and mechanism.

Example of modern wooden flute

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