# Equipment Basics Resource

## Introduction

A figure skate, consisting of a specific type of boot and blade, is a type of sporting equipment footwear that serves as an extension of a person and creates a connection between the body and ice surface. The boot, similar to an ankle brace, assists in controlling ankle and foot motion. The boot also works as a sensory awareness signal (proprioception) to enable the skater to know where their ankle and foot are positioned in relation to space. The blade assists the skater in performing specific figure skating elements on ice.

There are thirty-three joints and over one hundred muscles in each ankle and foot, consequently, there is a tremendous amount of motion occurring inside each skate. This ankle and foot motion controls just about every aspect of performance: balance, speed, power, and edge control but that motion is hidden within the boot and cannot be observed.

In this handout, we will explore not only the various products on the market today, but how the interaction between the skater and their equipment directly influences the skater's ability to produce ankle motion. This course will also provide observational assessment tools to identify proper or ill-fitting equipment, as well as offer coach directed equipment recommendations to help maximize the skills of the student and correct potential issues to reduce the risk of avoidable injuries.

This resource is compiled to assist coaches to:

- Have a working knowledge of current skating equipment on the market today.
- Know how the features of boot design influence joint motion.
- Understand that the way a skater wears their equipment impacts their progress and chance of injury.
- Identify a good fitting skate vs a poorly fitting one.
- Recognize faulty body mechanics can lead to equipment issues.
- Make good equipment recommendations.
- Teach the student how to properly use their equipment.

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## Part I: Skate Basics

### Evolution of a Figure Skate Boot

Just as the sport of figure skating has evolved through the years, so has the equipment. In the history of boot construction, almost all boots were exclusively fabricated using natural leather products that were heavy in weight, but flexible in design. Over the last few decades, as more skaters entered the sport of figure skating at an earlier age and more focus was placed on multi-rotational jumps, boot manufacturers turned to synthetic products with the goal of delivering a stronger, less deforming, higher-technological, and lighter product to help enhance performance and reduce fatigue.

### Sets vs. Boot and Blade Sold Separately

Today, there are many options of skating equipment available on the market ranging from pre-mounted sets (boots and blades attached by the manufacturer) to boots and blades sold separately. Pre-mounted skate sets are more affordable than boots and blades sold separately because they are designed for recreational or basic instructional skaters learning skating fundamentals including single rotational jumps.

Boot and blades sold separately are generally fabricated with higher technology materials needed for advancing or elite athletes who train several hours per week. Since the boots and blades are sold separately, skaters have the opportunity to choose a boot and blade combination that is ideal for them. Specialized blade mounting services performed by an experienced skate technician are required. More expensive than a pre-mounted set, the price for the boot and blade will vary depending on the models chosen.

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## Boot Strength & Manufacturer Rating Numbers

Boot strength is a term used to refer to how strong/stiff a boot is constructed and is determined by the type and quantity of reinforcing materials incorporated into the ankle cuff of the upper (see below). The stronger the boot is constructed, the more it will resist deforming "or breaking down" under repetitive load.

Most boot manufacturers rate their boot models using a number rating system. Based on 0-100 scale, the higher the number, the stronger and more resistant to deformation under load. Boot level ratings are assigned to each boot model by the boot manufacturer and not by an independent third-party company. In other words, the numbers are not an "industry standard" but are intended to be used as an informational tool to alert the skater where each model is positioned within the product line-up.

Stiffness rating numbers can be compared against another model within the same manufacturer brand but cannot be used to compare different brands. A rating of eighty with Brand A is not necessarily the same 80 rating in Brand B. Furthermore, we cannot assume that models within the same brand with 80 rating are exactly twice as strong as a 40 rating because that information simply isn't available.

Coaches can make boot rating number recommendations for future boot purchases based on the student's current boot rating as long as it is within the same brand. If not, the boot rating number should not be used as the number does not cross brands. It is important to note that boot stiffness becomes much stronger as the rating number increases, so it is advisable to slowly increase the boot rating number if the skater needs a stiffer boot rather than skip several levels.

## Boot "Support"

The word "support" has many meanings. Not to be confused with boot strength, boot support is "how" the figure skate boot is designed and intended to be worn so it provides the right stabilizing features in order for the skater to perform.

Different sporting footwear offer their athletes different levels of support depending on what is required for that sport. For example, a ski boot design with maximum stiffness or "support" will limit much of the ankle's natural range of motion. On the other end of the sports equipment footwear is the speed skate that has the minimum or even no

"support" thereby permitting full ankle mobility. Figure skating boot support falls somewhere in the middle of these two examples.

A well designed and properly fitting figure skate boot must assist in limiting excessive ankle motion and on the other hand, allow full ankle mobility to perform every required figure skating element. (This will be discussed in more detail in the tutorial video)

## Part II: Boot Features and Fit

### Basic Boot Anatomy

The boot portion of the skate that is attached to the sole is called the upper. The ankle cuff of the upper wraps around most of the ankle and lower leg. The midsole is the hard flat surface that the foot rests on and sits just above the outsole. The outsole of a boot, including the heel, is comprised of either leather (not wood) or PVC, a type of plastic. It is solid in design and is the attachment site for blade mounting.


Left photo: Different parts of an ice skate.

Right photo: Midsole of a skating boot.

Figure skating boots are specifically designed to position the ankle and foot in such a way so the skater can perform most efficiently. In this section, we are going to explore how all three of these features alter the way the skater moves.

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## Heel Height (Pitch)

The heel height of the boot, also known as "pitch," is the height of the boot's heel minus the thickness of the forefoot outsole (the thickness of the material under the ball of the foot). Pitch is similar to the high heels of ballroom dance shoes: it places the foot and ankle at such an angle that permits the ankle, knee, and hip joints to flex more easily.

On a higher pitched boot, the skater can bend more easily but they may not feel as stable or even feel wobbly, depending on their own balance and stability. On the other hand, a lower pitched boot may feel a bit more stable but may require the skater to exert more effort to bend. All figure skating boots have a pitch to them, but some are slightly higher than others.

From left to right: Examples of low, medium, high pitch boots.

## The Upper (including Ankle Cuff)

The ankle cuff is designed to offer overall stability to the ankle. The contact of the boot to the skin creates sensory signals back to the skater to alert them where their ankles (and feet) are in relation to space, known as proprioceptive feedback. (this will be discussed in more detail in the tutorial video)

Tall Medium Low

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Depending on the model, cuff heights range from low to tall. The taller the cuff, the more stability it provides, but just like with a ski boot it can become more resistant or even restrictive when attempting to bend the ankles. On the other hand, a very low cuff designed boot allows maximum ankle mobility but is less stable. A medium cuff height balances stability and mobility and is the most common cuff design on the market today.

A skater's height (overall leg length) will actually determine whether a cuff height is appropriate. A very tall skater may benefit from a taller cuff because it is in proportion to their height, but a much shorter skater would find a taller cuff harder to bend because of how high its position on the leg.

Photo: Tall cuff vs medium cuff height. The boot on skaters left leg sits much taller than the right side even though they are the same size and similar model within the same brand. The skater may struggle to bend their ankles as a result of the taller ankle cuff.

If a student is currently wearing a very high ankle cuffed skate that appears to be inhibiting ankle mobility, loosening the top laces will help improve ankle movement. Coaches may want to recommend a shorter ankle cuff skate to that student when purchasing the next pair of skates.

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### The Tongue and Laces

The design of the upper works in partnership with the tongue. The tongue and laces tied snugly will hold the foot within the boot, but at the same time, the boot must be laced loose enough permit ankle mobility.

The tongue and the laces are a bit like the brake of a car, which assists the skater in slowing ankle motion. This is most apparent during jump landings. In order for the tongue and laces to work properly, the skater must learn to engage their own muscles to slow down their body and soften the landing. If they completely rely on their tongue and laces to stop them from collapsing, it is as if they are slamming on the brakes at every jump landing.

## The Fit

### Fit the Foot

Skaters come in all shapes and sizes and so do their feet. Some have narrow feet while others have very wide feet. Some have very high arches while others have a collapsing arch structure.  Boot brands also fit very differently as well because each manufacturer uses their own uniquely shaped mold to fabricate their boots. Although there are certain brands that coaches may prefer for their students, it is important to keep an open mind in recommending brands because one brand on one skater will fit, feel, and perform very differently on another skater.

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Two very different foot types each in a different brand and model.
Upper photo:  Narrow and collapsing foot structure.  Lower photo: Wide and high arch foot structure.

## A Good Fitting Skate

It is imperative that boots fit the foot intimately with very little room for foot movement. Skaters should have their heels firmly positioned into the heel of the boot with the toes

close to or even lightly touching the front of the toe box when standing, knees straight. When the knees bend, the toes should pull away from the toe box of the boot. This is an optimal length for non-growing skaters. Girls up to age 13 and boys up to age 16 will need slightly more growth room but no more than one size greater than the feet measure, or the fit and function will be compromised.

## Correct Lacing Patterns

Laces should be worn very snugly across the top of the foot and the bottom few eyelets and hooks of the upper. However, the top two hooks should be fairly loose so the skater can move their ankles. (see image)

Left Photo: Snug lacing pattern across foot.
Right photo: Optimal lacing pattern is loose toward the top of boot.

## Visual Observations

Coaches can determine whether a skate fits well just by inspecting the lacing pattern. The lacing pattern should be approximately two inches apart (this is not exact, but just for visual observation) and the tongue should not sink down into the boot. (see images) If the lacing pattern looks narrow or the tongue looks like it is “sinking” this means the skates are likely too big and are poorly fitting.

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Left photo: Proper lacing pattern. Right photo: Tongue sinking inside the upper.

## Poor Lacing Patterns/ Over-tightening

Over-tightening or "taping" the top of the boot not only directly works against the design of the boot but also the function of the ankles. The ankles and feet are natural shock absorbers that are designed to handle impact forces. If the boots are tied too tightly at the top, it will inhibit ankle function, and those shock forces that come from the ice through the boot to the body will not be efficiently absorbed, but instead, will be transferred to other parts of the body like the knees, hips, and spine. Over time, this could lead to injuries.

Photo: Over-tightening, skate taping or duct taping is never recommended by any boot manufacturer.

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Skaters who over tie or "skate tape" around the ankle cuff of their boot are relying on their equipment to do the work that the ankle and foot muscles should be handling. Skaters will not learn to properly activate these muscles and over time, the bad habit of over-lacing becomes harder to break as the skater becomes more physically and psychologically reliant on their equipment.

In addition to increased risk of injury, the chances of early "boot break-down" become much greater as a result. Ironically, the skater often seeks out even stronger boots to overcompensate, requesting even "more support." Over-tightening the top of the skate can have many underlying reasons or issues:

1. Body alignment Issues/ Incorrect muscle activation. (see image)
2. Weak/poor ankle and foot posture. (collapsing arches/flat feet, see left photo below)
3. Ill-fitting skates, wrong size, or model.
4. Worn out skates.
5. Purchased equipment without consulting a professional.
6. Poor lacing habits.
7. Deformed or defective equipment.

Left photo**:** Skater on left has poor body alignment and collapsing arch structure. Knee should be positioned above the middle of the foot instead of falling inward.
Right photo: Skater on right has good alignment.

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## Poor Ankle and Foot Posture (collapsing arches/over-pronation)

The ankles and feet are the foundation of the body's overall posture. If a person has poor foot posture it means that their ankles roll inward and their arches collapse. If a skater has poor foot posture off the ice, they will more than likely struggle with balancing and performing on the ice because they are out of alignment. When joints are not aligned, muscles do not function optimally. Skaters can lose speed and power from lack of muscle strength as a result.

Left photo: Skater has straight heels, and the foot is well balanced.
Right photo: Skater heels roll inward, and the pinky toes roll outward. This is a sign of poor foot posture (over-pronates).

Skaters with these issues often struggle to find skates that are comfortable or may struggle with painful corns or calluses as a result excessive pressure from the boot. As the arches collapse onto the inside of the boot, the skater may roll inward on their blades as well. (see photos)

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Left photo: Skater has developed painful calluses from excessive boot pressure due to arch collapse. Right photo: Skater is relying on equipment to hold them up. Over time, the boot will prematurely deform due to poor foot posture and faulty body mechanics.

## Stronger Ankles and Feet

Due to the nature of this sport, all skaters should actively exercise their ankle and feet, regardless of their level of skating. Although overall foot structure cannot be changed, (i.e., a flat-footed person will not develop high arches) their ankle and foot health can be improved with off-ice strength and conditioning exercises.

Skaters will also need specific skate orthotics in their skates to reposition the foot into a more balanced position. It is important to point out that foot orthotics used for everyday street shoes are meant for entirely different purposes and are not the same as skate orthotics. Skaters should consult their pro shop for specific skate orthotics if they are struggling with fallen arches and poor alignment issues.

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Left photo: Skater with poor body mechanics has collapsing arches.
Right photo: Skate supports (orthotics) helps to restore arch structure and overall body alignment.

## The Importance of a Skate Fitting

A properly fitting skate is often a result of a skate fitting performed by a professional. A skate fitting is a service, and with that service comes a product.

- An assessment of skater's individual dynamics and skills
- Proper measurement and fitting, including offering different brands to ensure optimal comfort and fit.
- Comfort adjustments including heat-molding services.
- Alignment adjustments and sharpening services
- Quality control, warranty, and follow-up services.
- Knowledge of previous skate experiences to ensure better future fittings.

Skaters who purchase boots online or without the guidance of a professional fitter forego all the services necessary to ensure an optimal fit. This can lead to slow progress or even an increased risk of injury as most higher end boots require some sort of heat molding and/or custom fit. If a professional skate fitter is not locally available, skaters can contact a professional skate fitter that offers virtual fittings. Although it is not the same as an in-person fitting, a virtual fitting is better than no fitting at all.

## Part III: Figure Skate Blades

Although many figure skating blades look similar, there is a wide spectrum of blade choices ranging from low-level blades that are pre-mounted on a boot, to high-level blades with aggressive designs that are sold separately from boots. Blades sold separately tend to be fabricated with more advanced performance features and materials using high-technology production methods. The more features offered on blades, the higher performing, and generally more expense involved due to the elaborate manufacturing processes.

For many years, traditional blades were fabricated using carbon steel. Carbon steel is strong yet slightly flexible, a quality that many skaters enjoy. However, it is susceptible to oxidation and can rust easily.

### Anatomy of a Blade

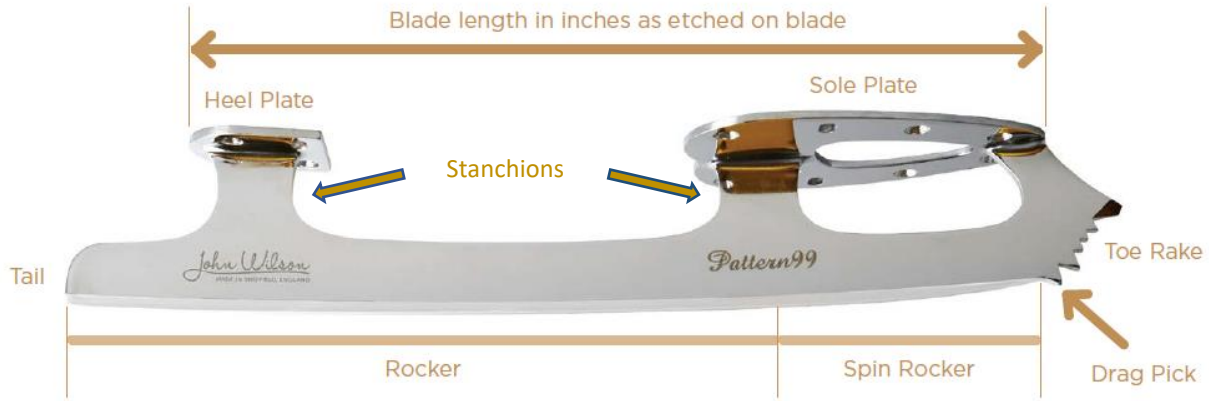


Photo: Blade is made using the same carbon steel metal throughout the entire blade.

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## Blade Runner

The blade runner is the part of the blade that makes contact with the ice. In recent years, some blade manufacturers have turned to stainless steel runners. Stainless steel blades are stronger than carbon and less susceptible to rust but are a much less flexible metal.

## Holder or Chasse

The holder or chasse is the part of the blade that connects to the runner. With some newer blade designs, manufacturers are using different materials such as aluminum, carbon fiber, and titanium in chasses to reduce overall weight.

Photo: The blade on the left is made with a stainless-steel runner but an aluminum holder. The blade on the right is made with a carbon fiber holder and carbon steel runner.

## Blade Rocker Profile

When we walk or run, we roll or "rock" through the bottom of the foot to create movement. On ice, the rocker of the blade mimics the rolling effect of the foot to reproduce similar movement patterns. Figure skate blades generally have at least three rockers: the forward or spin rocker, the primary rocker, and the tail rocker. The curvature of a rocker is stated as a measurement of length. This length is the radius of the circle that the blade's curve matches. The curve of a 7' rocker matches the curve of a circle with a radius of 7'. The bigger the number, the less curved the rocker, so an 8' rocker is flatter than a 7' rocker. Each of the several rockers on a blade has its own individual curvature and its own function.

- The primary rocker is situated between the two stanchions of the blade. It is the flattest, most stable part of the three rocker profiles. The ability to generate energy to create speed and power originates with the primary rocker.

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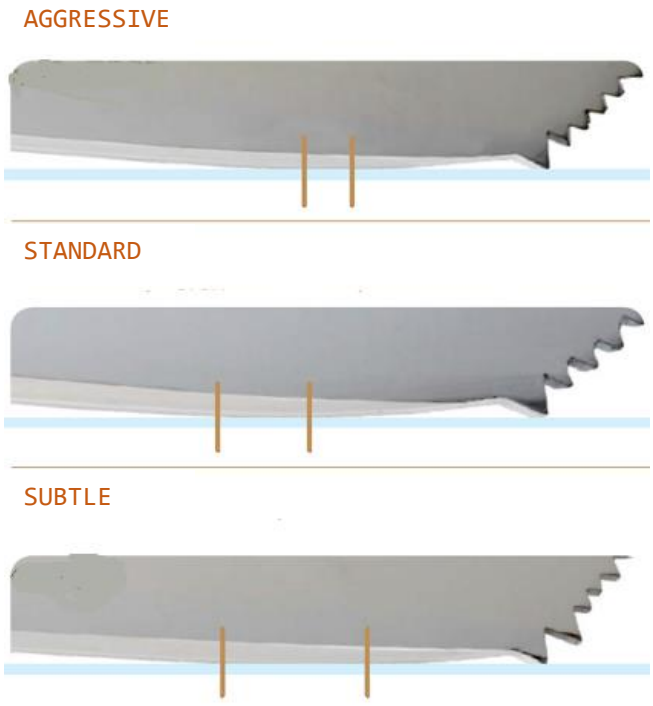
- The tail of the blade is sometimes considered part of the primary rocker, but in most models, it is slightly more curved than the primary rocker. The tail of the blade is used for balance and stability.

- The forward rocker, or spin rocker, has the most aggressive curve of all the rockers. This curve's radius is much smaller than the main part of the blade, often measured in inches instead of feet. Even among the forward rocker profiles, blades are designed with either a subtle, average, or most aggressive rocker profile. (this is covered in more detail in the video tutorial). Propulsion at jump take-off is produced with the assistance of the forward rocker. Spins and certain footwork and jump landings are performed on this part of the blade as well.



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Manufacturers list their blades either to be 7′ or 8′ rocker profiles but it is ONLY the primary rocker profile they are listing and not the other two rocker profiles. Coaches and skaters who are looking for "more rocker" should look for a blade with a more aggressive forward rocker. However unfortunately, forward rocker and tail rocker profile numbers are not readily available from most blade manufacturers.

## Blade Replacement

All blades will lose their rocker profile as a result of repetitive sharpening. A good way to determine if the forward rocker still has a good profile is to rock the blade up onto the toe pick and inspect how much the tail can lift off the ground. It is best to compare it to a new blade in order to determine if it is time for a new blade. If the skater is struggling with finding their spin center or having trouble with their jumps after several sharpenings, it may be an indication that the blade should be replaced due to the loss of the rocker profile.

Left: Blade on right heel lift is lower due to excessive sharpening compared to new blade of the exact model.
Right: Top blade has lost forward rocker from repetitive sharpening compared to new blade of the exact same model.

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## Toe pick

All figure skate blades have toe picks. They are used for jumping, spinning, and certain footwork maneuvers. Blade models offer different toe pick configurations called straight cut, hybrid or crosscut. These variations were designed to provide a different grip or bite on the ice. According to manufacturer's design intentions, straight cut teeth provide the maximum bite grip while the crosscut provide the least amount of bite grip. The hybrid is a combination of the two.

Straight cut Crosscut Hybrid

## Blade Size

The blade size is stamped on each blade by the manufacturer and is determined by the distance from the tip of the sole plate to end of the heel plate. It does not represent the total length of the blade runner. The length of the boot outsole determines what blade size(s) can be mounted to the boot. Different blade models have different length runners. In other words, the runner on a 9" blade model A could be either longer or shorter than the runner of a 9" model B blade. This change in length often influences performance even though the blades are technically the same size. Coaches should keep in mind that changes in blade model may impact performance due to the different runner length even if the blade "size" stays the same.

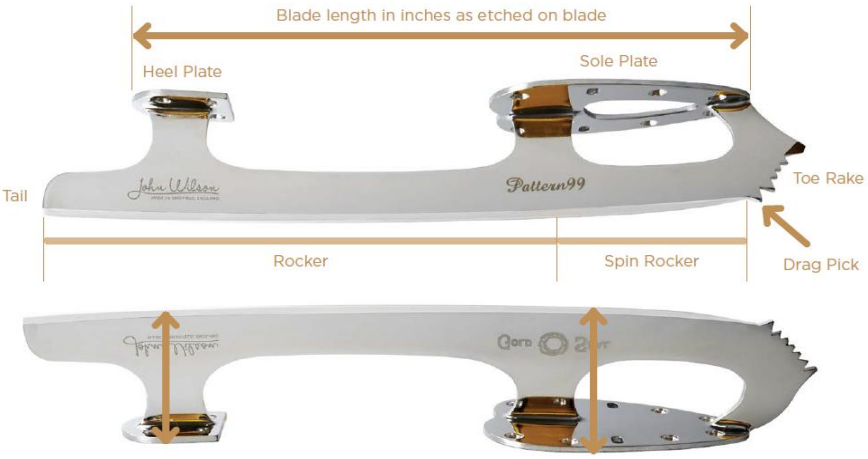


Photo: Both blades are same size, but the runner is longer on the bottom blade.

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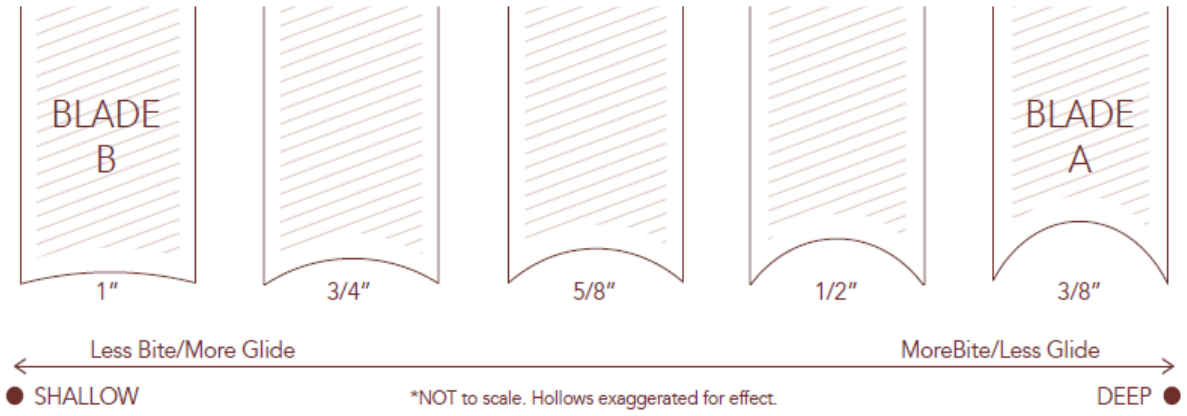
## Radius of Hollow (ROH)

A hollow grind is the concave groove excavated into the bottom of the runner of the blade. This groove makes two distinct edges which penetrate into the ice: the *inside* edge and the *outside* edge. The radius of hollow (ROH) is the depth of the groove carved into the blade. (see image). Once again, this measurement is the radius of the circle that matches the curve of the hollow. The less the ROH measurement, the deeper the edge bites into the ice surface. Deeper edges could provide more secure edge control, but conversely reduce the ability to create maximum speed.

The shallower the ROH is, the less the edge bites into the ice, and the less security a skater will experience. However, a shallower ROH has greater potential to generate more speed due to the shallower ice penetration. Ice conditions, body weight, experience, and personal preference will affect which ROH is optimal for each skater.




## Blade Sharpening

All blades need to be sharpened on a regular basis. When skated on, the combined body weight and friction of the ice surface will dull the edges of the blade. Most manufacturers recommend re-sharpening blades anywhere from 20-40 hours, but just like the ROH, an individual's sharpening schedule is a personal preference. Some skaters like their skates sharpened more frequently, while others prefer to prolong their time between sharpenings.

Eventually, all blades will lose their rocker profile due to numerous sharpenings. Skaters who skate on flattened blades will not be able to maximize their efforts. Although there is not a set amount of sharpenings before blade replacement, it is very important to

have a skilled sharpening technician sharpen the blades, so the least possible amount of rocker is removed from the blades each time.

Coaches should be mindful that most beginner skaters, especially children, are unaware that their blades are dull or that their blades need to be resharpened simply because they lack personal experience. Skating on dull blades can delay or inhibit progress. Coaches can remind their students to maintain a regular sharpening schedule to prevent unnecessary progress delays. Also, encouraging the students to have their blades sharp in time for competition day is also advisable. Ideally, blades should be sharpened a week or two before the competition or test day.

### Blade Alignment

Most sole and heel plates have oval slotted holes (see arrows in photo). Blades can be shifted slightly to make minor balancing adjustments to ensure optimal balance.
If a skater's ankles are rolling inward, that indicates the blade should be moved toward the inside of the outsole (laterally toward the big toe and inside of the heel) and conversely, if the skater is rolling outward, the blade can be moved outward. It is important to note that if a skater is wearing a skate too large, or over-pronates, making blade balance adjustments does not solve the problem, it just masks the underlying issue(s).

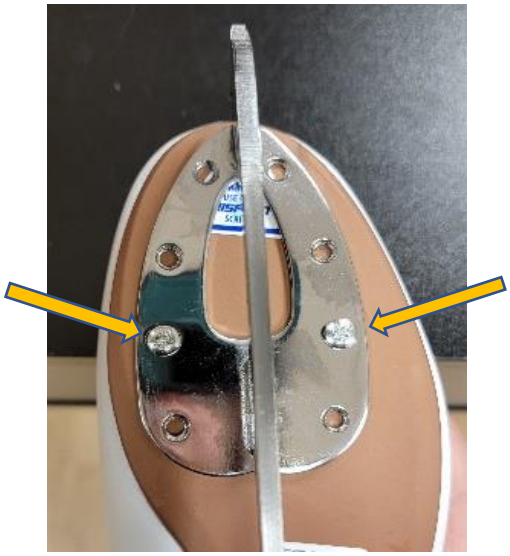


Photo: Screws are left out of bottom of boot so alignment adjustments can be made.

To check on-ice alignment, see if the skater can hold a one-foot glide for a certain period of time. (Beginner skaters may struggle with this but advanced students should be able to do so without difficulty). They should progress straight with little to no wobble. If the blade continuously pulls the student off the line of progression, a blade adjustment is in order. Very advanced skaters may be able to overpower the one-foot glide but will feel the malalignment in more advanced elements and edge control in take-off and landing.

Photo: Skater performing one foot glide to ensure correct blade alignment.