

## A Parent's Guide to Tuning Alpine Race Skis

### Introduction

The purpose of this guide is to provide basic information to a parent of an alpine race skier who is new to our team. This is not intended to be the “end-all/be-all” on this topic, nor is it intended to address ski repair – this is a basic guide on ski tuning. I am not an expert and am learning more all the time. I've also found ski tuning to be an in-exact ‘science’ which lends itself to debate regarding the practices that are ideal and those that are “totally wrong”... which can be very confusing to those trying to do the right thing for their sons’ and daughters’ skis. In addition, there are many variables, from the age of the snow on the race course, to the snow and humidity conditions at the exact time of the race, to the degree of expertise and skill the skier places on the skis on the specific run. As a result there can be no ‘proof’ of what is really is “right” for preparing a specific set of skis for optimal performance at a specific race. Thus, the debates continue and the topic is often shrouded in a “black magic” type of mystique. I don't portend to set the record straight. Instead, I offer some practical advice of the various options available for a parent who wants to know what's involved, and with this information, can make some informed decisions about how far they want to take this and what they'll be getting themselves into. This guide will explain some fundamentals of ski construction and snow contact and contains detailed instructions on how to hot-wax a ski and how to perform basic edge tuning.

Imagine you are given an opportunity to be in a bicycle race. Let's assume you're in reasonably good physical condition and feel able to compete. What are your chances of doing well if you use that old recreational bike in the garage that hasn't seen any action since before kids? Or, let's say you took the plunge and bought yourself a swanky road bike... but it's been collecting dust and hasn't been used or oiled in a long, long, time. The rubber on the tires is probably showing multiple cracks and age wrinkles. You can take your bike to the shop and have the bike boys put new tires on, clean the chains, tighten the brakes, balance the wheels, and generally get you ready to go. Or you could be your own bike mechanic and do it yourself. If you were racing your bike at several major races, the costs of taking it to the shop might start adding up and you might look pretty hard at learning how to do it yourself. But you've got to learn how to do it right, or you could end up doing something that actually creates a safety hazard, let alone not optimizing it for speed. Plus, you need to buy the tools necessary to do the job correctly, some of which are very specialized and can be very expensive. In general, that's pretty much the situation you're faced with if you are like I was... a parent of a young alpine racer (my son was eight years old when we started) with no clue what “tuning” a ski meant or what was involved. As I started to learn, I got a lot of well-meaning advice that was, in retrospect, only partial information. Which actually lead me to make some pretty bad mistakes that actually made my son's ski's slower... not exactly the boost of confidence he was hoping for from my efforts.

At a broad level, the tuning of skis can go from some basic things you can do with reasonable cost and can go all the way up to exotic materials and special equipment that be expensive and require a lot of personal time. From our bike race example,

Lance Armstrong and the Discoverey team had full-time, well-paid professional bicycle mechanics working on \$10,000 machines. Similarly the US ski Team has a number of professional ski tuners to exactly match the hundreds of skis provided to the world Cup team. These experts do nothing but fine tune the race skis for the individual racer and exact weather conditions of a particular event. Unless you have an Olympic racer in training, I think we can safely rule out the full-time dedicated ski tuning specialist, so you can keep the spare bedroom open for guests and visiting family.

### **First Step – Assess Your Needs Before Doing Anything**

Okay, before we plunge deeper into this topic, I strongly recommend that you make a subjective assessment of your son's/daughter's skiing skills. Ask their coaches and get a sense of where they are on a scale of 1 to 10. The more advanced and skilled your young athlete is, the more they will benefit from frequent tuning. Also, factor in how many races you're planning to go to for your child to race. Taking this from the early stages, let's say your son/daughter is on the Development Team and plans to race in one of our WIJARA races, probably toward the end of the season. You would probably be best served by taking your child's skis in to the ski shop for periodic waxing and a "full tune" the week before the race. Although this can add up cost-wise, our team get's a discount for these services at the shop and overall you'll save money and time for this level of tuning needs for your child.

### **Principle #1 – Ski Bases, Friction and Wax**

If you're still reading, you have come to the conclusion that your child will be competing in a few races and his/her skills are such that more frequent maintenance would help them be better and faster. So, let's talk about some of the principles going on that lie behind this whole "tuning thing". I want you to think back to your high school physics class. Remember friction? Think about the bottom of a ski as it glides across the snow. There are two topics you need to understand. First, the main area of the bottom of the ski is called "the base" and today's ski bases are made of a synthetic material that is actually porous. (There's another term you may have heard about the bottom of a ski called "structure", but that's an advanced topic that we'll get to later.) When shipped from the manufacturer, that porous base material has been saturated with a special formulated wax.

As your child skis, they create two kinds of friction as the bottom of their ski scrapes across millions of ice crystals (that is after all what snow really is). Underneath the ski a very thin film of water is created as it travels across the snow. The thickness of this film of water is a delicate balance between "wet" friction (caused by microscopic heat) and "dry" friction from exceptionally cold and dry powder properties of some snow. The wax is shed from the skis to create the 'glide' of a fast ski. The goal of the wax is to optimize that balance between wet and dry friction – too much wet friction will result in too much water and a wet drag or suction will occur and slow down the ski... on the other hand, too much dry friction will also result in a dry drag and slow down the ski. But keep in mind that the ski base has only so much wax in its "reservoir". Eventually, the wax is drawn out of the base, leaving it 'dry'. If you look at an old pair of well-used skis and

see grey or white streaks along the otherwise black material, that's an indication of a very dry ski base.

### **Fundamental #1 – Wax Your Skis!**

If there is one thing you should learn to do, it's how to wax your skis. Regular waxing of skis, particularly alpine racing skis, is vital to not just speed but also control and the ability for your young athlete to improve their skills and learn advanced concepts from their coaches. Even in more advanced tuning, waxing is a constant regimen. So, let me repeat that first comment...if there is one thing you should learn to do, it's how to wax your skis. The more the skis are used for training, practice, etc., the more friction, the more friction, the more wax is drawn out, the more wax drawn out, the slower the ski will be as it fights a basic law of physics. How often should they be waxed? Most guidelines suggest that skis should get a wax treatment after every 4-5 days of skiing. So, Dad/Mom, you need to teach them how to do it themselves, too. One day you'll be busy and won't have the time...they need to be able to prepare their own skis before a race or during the week for training. If you want to jump into waxing right now, see the section below about home waxing, tools and techniques.

### **Principle #2 – Edges**

The other main topic you should know about skis, especially for racing, are edges. Along the very outer edge and on the outer edge on the bottom of each ski is a narrow strip of metal that runs almost the entire length of the ski... from near the "tip" to near the "tail". This metal strip is conveniently referred to as the "edge". The design of the ski has a gentle curve starting from a wider area near the front or tip of the ski, becoming narrow where the ski boot attaches to the binding, and ending with a flared end or 'tail'. The metal edge follows this curve and allows the skier to easily make turns on the snow. Ski racing depends on the skier being able to execute turns at optimum locations along a race course to take the best 'line' and complete the course in the shortest time possible. The ability to execute those turns at the optimum locations requires two things: (a) skill and physical ability of the skier and (b) sharp edges on the skis.

### **Fundamental #2 – Beveled Edges**

At the peak of momentum during a hard turn, the edges are the only part of the ski that's in contact with the snow. Its no surprise that a dull edge doesn't 'cut' a turn as well as a sharp edge does. On icy conditions, dull edges are not only poor at turning, they can actually be dangerous. Like a high quality kitchen knife, the more it's used the faster it loses it sharp edge. The more a ski is used and the more aggressive the skier is on their edges, more the edges lose their razor sharp edge from continually scraping against millions of ice crystals. Snow is surprisingly abrasive and can dull edges in as little as two days. But sharpening ski edges is not like sharpening a kitchen knife. So put the file down from your workbench and read some more... If not done correctly, the angle of the edge (called the "bevel") can make the ski either more "grippy" or the reverse and "rail out" or slide across the turn and not make the cut.

Look very closely at the metal edge on a ski. There are two sides. There's the very thin strip that is flush with the base on the bottom of the ski. That is conveniently referred to as the "base edge" and the degree of bevel on the base edge will affect the ability of the ski to pivot on the snow. The more base edge bevel, the easier it will be to pivot from side to side. Along the outmost edge of the ski is the other side of the metal edge. Again, conveniently this is referred to as the "side edge". Side edges impact the grip a ski has on the snow surface. Higher angles give more grip, but can cause the ski to 'rail out' for a less experienced skier. Also, higher angled side edges are quicker to dull and may be more difficult for lighter ski racers (women and children) to recover from being up on their edge. Another thing to keep in mind is, once you start removing some of the metal to increase the bevel, you can't go back. This is an advanced topic that I want to revisit in the advanced topic section on edges. Suffice it to say that edges play an important role in how well a ski racer can train and perform and maintaining them is a key issue in tuning skis.

### **Categories of Race Parent Ski Tuning Involvement**

There are three categories of ski tuning you should think about:

- For beginning and basic levels, let the pros do it. Take the skis to the shop about every 3 weeks for a wax job and ask them to sharpen the edges every other visit. About a week before a race, have the shop do a "full tune".
- For more advanced and aggressive skiers (and willing parents to take the plunge), the next step up is to set up an area at home to do your own waxing during the season. This requires an investment in a set of tools and supplies, but is "the one thing you should learn to do..." For this level, I'd recommend you take the skis to the shop for sharpening the edges about every 3 weeks and get a full tune the week before the race.
- For advanced racers and DIY enthusiasts, there's the 'top tier'. This is adding more specific gear to your wax equipment that will allow you to work on side and base edges. You'll probably want to invest in "travel gear" that you can use to freshen up the skis during a race to keep them in optimal condition before each run. (This part is especially appealing to OCD parents.) For this level, I'd recommend you still take advantage of the expertise of the local ski shop for occasional full tunes (to smooth out all the little mistakes and bloopers you've probably made in your tuning efforts).

### **Home waxing**

First you need to pick a place in your home that will be the waxing area. You shouldn't mind if the area gets messy. No matter how hard you try, wax drippings, shavings and particles will get all over this area. Believe me, I've tried and I'm a neat freak. If you want to use drop cloths, tarps, etc. that will help contain the shavings and scrapings, but you'll still track them all over the place on your shoes. Okay, you'll need a very stable table or set of sawhorses with a long board surface that's well-clamped (you're going to be pushing down along the ski so you don't want it wiggling around on you). You also need good lighting. Odds are you'll be waxing at night, plus you need to examine the skis and your work so good lighting is critical. If you're going to do this, you need to do what's called "hot waxing". There are other waxing approaches out there, including a

simple liquid paste that's swiped on and lightly buffed ... "*voila*" a waxed ski...how simple is that? Well, remember the 'reservoir' concept? Hot waxing is the best way to refill that reservoir and generally regarded by everyone in the industry as the preferred method. Simpler wax treatments don't last more than a few runs down the slopes. Hot waxing is a bit tedious, but it offers the best performance.

## **Waxing Tools**

So, if you have your space set aside, your stable work table/board and good lighting, here is a list of the basics for waxing:

- Ski vise (to hold the ski still while you work on it)
- Ski brake retainers (to keep the brake out of the way while you work)
- Waxing iron (to melt the wax and spread the wax across the base)
- Plexiglass wax scraper (to remove excess wax from the ski base)
- Brass brush (to help clean and prepare the ski before waxing begins)
- Nylon brush (to help remove finer particles of excess wax & polishing)
- Inexpensive wax for "cleaning" (used to remove dirt from the base)
- Treatment wax (used to refill the reservoir)

### **Estimated cost for the basic tools**

Ski vise:	\$80	-	\$100
Brake retainers:	\$4	-	\$5
Waxing iron	\$40	-	\$50
Wax scraper	\$5	-	\$7
Brass brush	\$10	-	\$20
Nylon brush	\$8	-	\$15
Inexpensive wax (large)	\$10	-	\$30
Treatment wax (large)	\$20	-	\$40
<b>TOTAL</b>	<b>\$177</b>	-	<b>\$267</b>

### **A word about waxing irons**

Some people say you can get by with an old home iron that you never will use on clothes again. Don't do it. (I did.) Clothing irons have wide fluctuation in temperatures and you're never really sure what the temperature is of a clothing iron. If the iron is too hot, you could damage the base material of the ski. Several manufacturers' make a waxing iron that is specifically designed for this task. It is much more accurate than an old clothes iron and it has a thicker and smoother base which minimizes the temperature fluctuations as you apply the wax. It's a lot cheaper to spend \$40 - \$60 on a decent waxing iron compared to the investment in a new pair of skis to replace the ones you damaged with a clothing iron.

## **The Waxing Process**

The basic idea is to (a) clean dirt from the ski, (b) iron 'in' fresh wax into the ski's wax 'reservoir', (c) scrape off and brush out excess wax from the ski, and then, (d) buff and polish the wax along the base to create a smooth surface ready for use. You should plan about an hour or so to do this procedure from start to finish. You'll use about 12 grams of wax for each pass on a pair of skis. Let's dig deeper into the details of each step in the waxing process and what you do.

### **Step One – Preparation**

- Some people put blue painter's tape around the bindings to protect them from wax drippings. If you want to do this, now is the time before you start waxing. You can tape over pretty much everything except the edge of the ski.
- Take one ski and pull or push the brake down so that it clears the base and hold it in place with a brake retainer. Then put the ski into the ski vise at your work area with the bottom of the ski facing upward and gently tighten the vise to hold the ski firmly in place. Plug in and turn on your waxing iron to warm up at the temperature setting for your wax.
- Take your stiff brass brush and stand at the tail end of the ski and start a firm brushing of the base with long strokes from tail to tip (that's not a typo... from tail to tip). This will help remove oxidation and expose the base structure<sup>1</sup> clogged with dirt and old wax.
  - o Do 3 full length passes from tail to tip
  - o Next, break the ski into thirds and work each third 3 times – same direction
  - o Take 2-3 more full length passes (tail to tip)
  - o Wipe off the surface of the base with a low-lint rag

<sup>1</sup> Note: I'm going to cover the topic of base 'structure' in more detail in the advanced section. But a quick explanation is to think of structure like the treads on a car tire – they channel water underneath as the car moves along a wet surface. The base material has a very fine pattern etched into it that does a similar job – it channels the thin film of water that's created from the sources of friction between the ski and the snow. Just as you wouldn't want your tires to be completely without tread, so too you don't want the ski 'tread' (structure) to be clogged up with dirt and wax.

### **Step Two – Hot-Scrape Cleaning**

Regardless of claims to the contrary, don't use a liquid solvent to clean the base of your skis. Experts agree that this liquid, while it does remove the old wax and dirt from the skis, dries out the base material unnecessarily. If you feel compelled to buy some, use it to clean your equipment but don't use it on your ski bases!

Instead use what's known as the hot-scrape method for cleaning your skis. The idea is to use warm/liquefied wax to "wash out" dirt and pull out old wax.

- Choose an inexpensive wax... hold it against your waxing iron above the ski so that the wax melts and runs off the iron onto the ski base.
- After you've created a good long trail of dripped wax along the ski, starting at the tip and heading toward the tail of the ski, iron the wax to melt it in a smooth continuous motion, working your way down the ski.

- You want your iron to be a little bit warmer than 'normal' for this so you can scrape it off while it's still liquid...so, you should have about an 8" – 12" trail of liquid wax as you move the waxing iron along the ski
  - Note – don't hold the iron or otherwise leave it on one place on the ski for any extended period of time. Too much heat can damage the base material. Keep the iron moving.
- Put the iron down (but still on... you may want to invest in an iron 'holder' for this – they cost about \$20 - \$25)
- While the wax is still warm and in a near liquid state, take your plexiglass wax scraper and, starting at the tip of the ski, scrape the excess wax off the ski.
  - Since the wax is warm, it will easily shred itself off in a ribbon as you scrape along the ski. Continue to scrape until all the excess wax is off.
    - Don't be an 'iron man' in scraping. Excessive force in scraping causes the plexiglass to bend and it will actually start creating a slightly concave impact into the base. Don't curve or bend the scraper. Keep it straight across the ski at an angle as you pull or push to scrape wax.
  - If the scraped wax looks grey, that's dirt. If so, do this process again until the scraped wax comes off white and clean. You've now cleaned the base of the ski and it's ready for waxing.

### **Step Three – Wax for Skiing and Training**

- Select your "treatment" wax – which should be a wax that covers most temperature ranges that we are likely to experience on our team in the Midwest: usually warm and wet snow conditions.
- Using your wax iron, drip on a coat of fresh 'treatment' wax and iron it into the base from tip to tail, similar to the technique above but a little bit slower to soak this wax into the base of the ski.
- Set the ski aside to cool and absorb the wax at room temperature. While the ski cools, use the time to switch skis and do the first three steps on the other ski.
  - This wax 'reservoir' is now warm and soaked with wax. The 'pores' are open and the wax is continuing to be absorbed. Experts recommend allowing the ski to slowly cool and thereby allow more wax to be embedded into the base. You should allow at least 20 minutes, although some pros suggest 3-4 hours.
- After cooling, scrape off the excess wax using your scraper working from tip to tail. Continue using the scraper until you cannot remove any more excess wax.
- Use a nylon brush, working from tip to tail in long smooth strokes, to pull out more wax from the base structure and to begin polishing the wax on the base.
  - If you want to bump it up a notch, follow this step with the same procedure using a horsehair brush to do more polishing and reduce static.
- Finally, use a clean "Scotch Brite" or fibertex pad to perform a final polish of the wax on and into the base structure.
- Remove any wax that may have dripped on the ski or bindings, including the edges.
- Congratulations! You're done!

This basic process is followed with minor variations to apply special formulated waxes that are designed to manage that balance between dry and wet friction in specific snow conditions. There are waxes with fluorocarbons, with graphite, some made for wet snow, some for dry snow, some for new snow, some for old snow. And some of these special chemical mixes are very expensive... would you believe \$100 for one gram? There are entire lines made by different manufacturer's and reminds me of fishing lures, everyone wonders if theirs is the right one for the day. This is an area that is famous for a near black-magic approach and at races it's not uncommon to see special waxes being applied to race skis within the hour before the race to fine tune the wax 'mix' and layers for the fastest ski. This is an OCD parents' dream!

### **Advanced Topics – Edge Beveling**