The fast facts on fast wax

DON'T BE A "DOPE" ON THE SLOPE BY JACK MOORE

FOR MORE THAN 150 years, technicians for the world's fastest racers have been rumored to harbor secret wax formulas. In the 1850s, they were known as "dopemakers" who concocted exotic recipes for California miners and mountain men who straightlined down Sierra Nevada slopes on 450-centimeter (13-foot-long) skis at speeds up to 80 mph. The ingredients of Steward's Old Black Dope, for example, included sperm whale oil, pine pitch, camphor, balsam fir and spruce oil. Later, new waxes evolved using ingredients such as beeswax, tars and natural resins.

From those early days until the 1960s, most all skis had wood bases. Left untreated, they'd soak up moisture like a sponge, not only creating significant drag, but also icing up at freezing temperatures to literally stop dead in their tracks. To avoid this, they were waterproofed using pine tar, which was heated into bases and allowed to dry before wax was applied. In those days, about 97 percent of all skiers waxed their bases.

Today, only 3-4 percent of skiers wax regularly. This flip-flop occurred about 40 years ago, when polyethylene (P-Tex) appeared on ski bases. Although P-Tex was more water-repellent (hydrophobic) than wood bases, most skiers mistakenly assumed P-Tex didn't need wax. Ski manufacturers didn't discourage this notion (and, interestingly, still don't), because waxing was perceived to be an inconvenience that might discourage sales ... and, perhaps, also because unwaxed P-Tex bases wear faster, thereby encouraging more frequent ski sales.

In reality, P-Tex is a thirsty base material that sucks up moisture from the snow if you don't apply wax regularly. The accompanying performance loss can be significant, because a waxed base is more durable, easier to turn and up to 30 percent faster than an unwaxed one.

HOW WAX WORKS

Wax improves glide by fighting various types of friction, including:

- **Wet friction** *water absorbed by a dry base creates drag*
- **Dirt friction** *sharp or sticky contaminates in the snowpack create drag*
- **Static friction** *static "cling" is generated when a base slides over dry snow*
- **Dry friction** *sharp snow crystals literally tear at P-Tex bases to create drag*

Admittedly, there are rare situations when snow feels slow whether you wax or not, such as wet new snow, dirty old snow or cold dry snow. In fact, somewhere around minus-10 F (minus-23 C), snow can feel as slow as sand, which explains why ex-Olympian Bill Koch used to cross-country ski along ocean beaches for his high-resistance training. The fastest glide usually occurs at temperatures just below freezing (28 to 30 F, or minus-2 to minus-1 C), when warmer temperatures create more moisture in the snowpack to provide greater base lubricity and glide speed.

HYDROCARBON RACE WAXES

The primary foundation of modern race waxes is paraffin, a hydrocarbon petroleum byproduct that boasts good hydrophobic properties. It penetrates deeper into P-Tex bases and lasts longer when heated in using a hot-wax iron or Wax Whizard tube. Less durable applications can be made by rubbing on a thin layer of wax like a crayon and then vigorously rubbing it in with a wax cork, or by applying a paste or liquid wax.

Hydrocarbon waxes are the first layer usually applied to race bases. They're designed for specific temperature ranges (see accompanying hydrocarbon wax chart). Many manufacturers offer hydrocarbon race waxes

JONATHAN SELKOWITZ

Choosing the right wax

BY JACK MOORE

(we recommend working with just one brand initially to simplify matters), which are usually available in three to five different temperature ranges, such as:

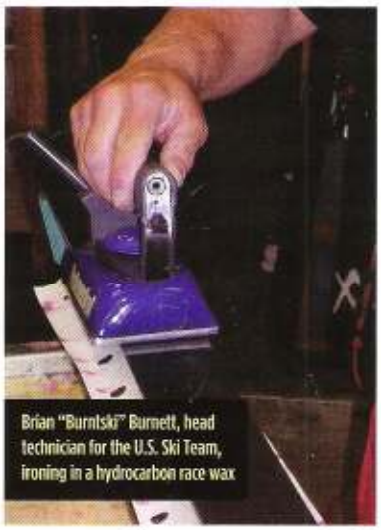
• **Cold wax** — For snow temperatures approximately 10 F (minus-12 C) and below. This is a hard wax mix of paraffin and synthetic paraffins, hardening additives that make wax more durable, abrasion-resistant and immune to scratching by sharp snow crystals (dry friction).

• **Midrange wax** — For snow temperatures between 10 F (minus-12 C) and 28 F (minus-2 C). This is a medium wax formulated to counteract the effects of both moderate dry and wet friction.

• **Warm wax** — For snow temperatures 28 F (minus-2 C) and above. This is a soft wax mix of paraffin and silicone, a hydrophobic additive that makes wax more water-repellent to combat wet friction.

SPECIALIZED HYDROCARBON WAXES

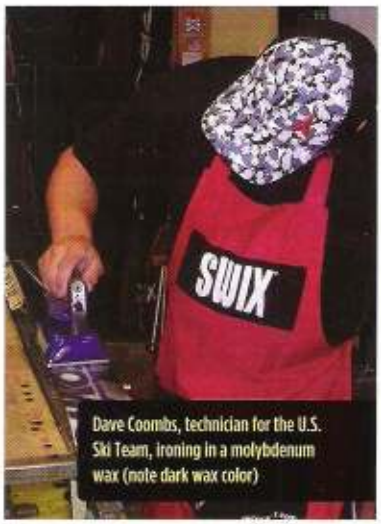
• **Extreme cold wax** — Coarse snow crystals, man-made snow and ice are especially abrasive and can strip wax from bases very quickly, which can create base "burn," an oxidizing process that seals P-Tex and diminishes its ability to absorb future wax. Extreme cold wax powders are made primarily of hard synthetic paraffins to combat this. They're sprinkled on bases, or at least along edges where base burn risk is greatest, before hydrocarbon race wax is dripped over it. The two can then be melted in together.



Brian "Burnlski" Burnett, head technician for the U.S. Ski Team, ironing in a hydrocarbon race wax

• **Graphite/molybdenum wax** — These waxes are applied for fine-grained snow when humidity is low and temperatures are cold to enhance the static-reducing benefits of graphite (black) bases. They also help keep bases cleaner by reducing static "cling" that attracts contaminates such as dirt, ash, lubricants and pollen in old snow, that become increasingly common in spring. They can also help quell "hot spots" that otherwise develop underfoot and increase base suction by equalizing temperatures along the full length of the base. To apply, rub on a thin layer of the wax to better distribute the graphite/molybdenum particles evenly over the entire base surface, then drip on the hydrocarbon race wax of the day and heat them in together.

• **Warm wax** — New bases, or any bases that have recently been stone ground or sanded, are especially dry, dirty and thirsty. Base prep wax is a soft paraffin wax that melts more deeply into P-Tex. It should be applied with a wax iron using the "hot-scrape" technique, where it's repeatedly heated in and immediately scraped off until no more dirt or discoloration appears in the wax shavings. Follow this by 2-3 more hot-wax applications, allowing time between applications for the base to cool completely before scraping. The base should now be ready for hot waxing with your hydrocarbon race wax.



Dave Coombs, technician for the U.S. Ski Team, ironing in a molybdenum wax (note dark wax color)

FLUOROCARBON WAXES

Unlike hydrocarbon race waxes comprised of carbon molecules with neutrally charged hydrogen atoms, fluorocarbons contain negatively charged fluorine atoms. Somewhat like Teflon, they repel water more efficiently, reducing wet friction between the base and the snow. They also help keep bases cleaner in dirty snow by repelling dirt particles, which, like their fluorine atoms, are negatively charged.

Fluorocarbon waxes are offered in specific temperature ranges as well as a range of formulations from relatively inexpensive low-fluoro mixes (2-3 percent fluoro content for low-humidity conditions when it's hard to make a snowball), to mid-fluoro (3-5 percent fluoro content for mid-humidity conditions when it's easier to pack a snowball), to pricier high-fluoro

Different wax companies follow varying but somewhat similar standards of humidity levels:

Humidity	Swix	Toko	Dominator	Holmenkol
Low	0-50%	0-40%	0-25%	0-50%
Medium	50-65%	40-70%	25-65%	50-75%
High	65-100%	70-100%	65-100%	75-100%

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Consider the following conditions before deciding on the best race waxes of the day:

1. Snow temperature – measure this with a thermometer inserted within the top quarter-inch of the snowpack for accurate results. This will usually determine which temperature-range wax to use.

2. Air temperature – this is usually fairly close to the snow temperature, but if it's significantly warmer than the snow temperature, it will tend to warm up the snow, which can affect your choice of wax by race start time.

3. Snow crystals – if snow crystals on the race course are new and sharp, you need a harder wax to prevent crystals from digging into the base and creating drag. If crystals are rounder and wetter, a softer wax will provide greater water repellency and, therefore, faster glide.

4. Air and snow humidity – this will determine if you want to choose low, medium or high fluoro waxes. The higher the humidity, the higher you usually want the fluoro content in the wax to be.

5. Wind – if the air is dry, wind will tend to decrease moisture in the snow, whereas if it's foggy or moist, wind can add moisture to the snow.

6. Solar exposure – if critical flat sections on the course are in the shade, wax colder, and if they're in the sun, wax warmer.

7. Miscellaneous – there's always more considerations you can factor in, such as graphite additives to combat static conditions in very dry snow, wax hardeners for very abrasive ice or man-made snow. How far you want to take it is up to you, but at least pay careful attention to the first three or four factors if you want to finish on the podium.

Backshop

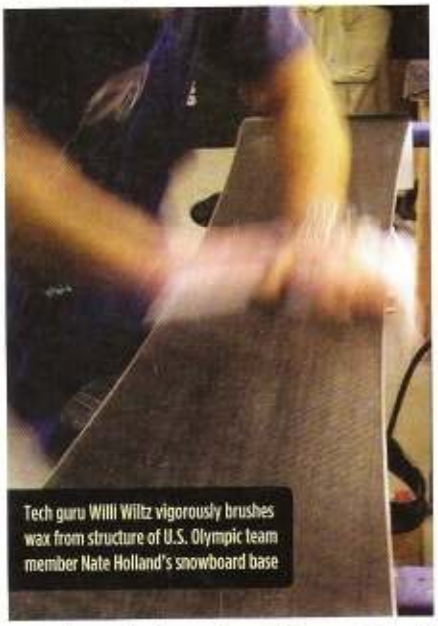
mixes (5-15 percent fluoro content for high-humidity conditions when it's easy to pack a wet snowball).

Fluoro waxes are best applied atop their hydrocarbon race wax counterparts. Assuming that humidity levels warrant it (and your budget allows it), you can also apply layers of increasing fluoro concentrations over your hydrocarbon wax, i.e. low fluoro wax layer over hydrocarbon wax layer, then higher fluoro over the low fluoro, etc.

"Hot scrape" bases until wax shavings are clean with no discoloration ... this indicates your base is really clean

FLUOROCARBON OVERLAYS

One hundred percent fluorocarbon overlays are applied last, assuming that snow conditions warrant their use. These are available in a variety of block, powder or liquid forms. Although blocks and powders can be applied using a wax iron (this is sometimes done for longer nordic ski races where durability is paramount), hot waxing requires not only more wax, but also very high temperatures that can accidentally cause base damage. You can safely avoid these concerns for all alpine races and most nordic races by rubbing or sprinkling these overlays on, then heating them in with a cork or felt pad, followed by polishing with a fine brush (nylon or horsehair).



Tech guru Willi Wiltz vigorously brushes wax from structure of U.S. Olympic team member Nate Holland's snowboard base

As a general rule, fluoro blocks are preferred over powders by masters and juniors racers since they are easier to apply in windy conditions (such as race starts), can be applied more evenly over the entire base and provide nearly double the number of applications of the same amount of powder. Liquid overlays have gained popularity and are often applied either alone or over block and powder overlays, since their application is easy and provides full base coverage even down to the deepest recesses of base structures.

Finally, a coat of low-fluoro paste wax should be applied to ski or snowboard sidewalls and tops to help improve glide when cranking turns, as well as help prevent unwanted snow buildup on topsheets. SR

Jack Moore is the founder and owner of Tognar Toolworks (www.tognar.com), a worldwide purveyor of ski and snowboard tuning tools and waxes. He welcomes your ideas and feedback at tools@tognar.com.

FLUOROS

F	C	Dominator	Holmenkol	KUU	Race Service 1	Swix	Toko
36+	2+	FX99 FX66	HYBRID FX YELLOW	MACH FLUORO MOIST	CF-1	LF10/HF10	DIBLOC LF DIBLOC HF YELLOW
34	1						
32	0						
30	-1	FX33					
28	-2				CF-2		
26	-3	FX88 FX55 FX22	HYBRID FX RED	HYBRID FX WHITE		LF8 HF8	
24	-4						
23	-5						DIBLOC LF DIBLOC HF RED
21	-6						
19	-7			MACH FLUORO UNIVERSAL			
17	-8						
15	-9						
14	-10	FX77 FX44 FX11	HYBRID FX BLUE		CF-3	LF6 HF6	
12	-11						
10	-12						
8	-13						
6	-14						
5	-15						
3	-16						
1	-17						
0	-18						
-2	-19						
-4	-20						
-5	-21	FX07 FX04 FX01	HYBRID FX GREEN	MACH ALPINE FLUORO COLD	CF-4	LF4 HF4	DIBLOC LF DIBLOC HF BLUE
-7	-22						
-9	-23						
-11	-24						
-13	-25						
-14	-26						
-16	-27						
-18	-28						
-20	-29						
-22	-30						
-24	-31						
-25	-32						

HYDROCARBONS

F	C	Dominator	Holmenkol	KUU	Race Service 1	Swix	Toko
36+	2+					CH10	
34	1						
32	0						
30	-1	HX99	ALPHAMIX YELLOW	MACH ALPINE MOIST	ZF-2	CH8	SYSTEM 3 YELLOW
28	-2						
26	-3						
24	-4	HX88				CH7	
23	-5		ALPHAMIX RED				SYSTEM 3 RED
21	-6			MACH ALPINE UNIVERSAL			
19	-7						
17	-8						
15	-9					CH6	
14	-10	HX77			ZF-3		
12	-11						
10	-12						
8	-13						
6	-14						
5	-15						
3	-16						
1	-17		ULTRAMIX BLUE				
0	-18	HX07		MACH ALPINE COLD	ZF-4	CH4	SYSTEM 3 BLUE
-2	-19						
-4	-20						
-5	-21						
-7	-22						
-9	-23						
-11	-24						
-13	-25						
+14	-26						
-16	-27						
-18	-28						
-20	-29						
-22	-30						
-24	-31						
-25	-32						

OVERLAYS

F	C	Dominator	Holmenkol	KUU	Race Service 1	Swix	Toko
42+	5+					FC10(L)	
40	4						
38	3						
36	2						
34	1						
32	0			FLUORO SPEED BLOCK MOIST	RS-0 RP-0		
30	-1						
28	-2				RS-1 RP-1		
26	-3						
24	-4				RS-2 RP-2		
23	-5						
21	-6						
19	-7					FC10	
17	-8						
15	-9						
14	-10			FLUORO SPEED BLOCK COLD	RS-3 RP-3	FC7	
12	-11						
10	-12						
8	-13						
6	-14						
5	-15						
3	-16						
1	-17						
0	-18						
-2	-19						
-4	-20				RP-4		
-5	-21						
-7	-22						
-9	-23						
-11	-24						
-13	-25						
-14	-26						
-16	-27						
-18	-28						
-20	-29						
-22	-30						

SCOTT CHURCHILL (CHARTS); JACK MOORE (2)