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Solve three problems with a single solution

A Treatment for Silnylon Floors

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A note from the author: Silicone impregnated nylon ("silnylon") is one of the most interesting of the high technology fabrics that's been introduced to the outdoor products industry over the past several years. So interesting, in fact (at least to me), that I'm currently working on a separate article entitled "Silnylon: The Inside Story" that will discuss this material's history, physical properties, manufacturing processes and legal issues. This first piece is more narrowly focused and deals primarily with silnylon's use in backpacking tent floors, an application for which, as it turns out, it's not particularly well suited.

Nevertheless, because several ultralight shelter manufacturers are using silnylon as a flooring material, and since buyers frequently complain about the associated problems (often through Internet discussion forums), I decided to document this do-it-yourself treatment that can serve as a single solution to this fabric's three primary floor-related problems. The process described below was developed about 18 months ago and has subsequently undergone extensive field testing to validate its effectiveness.

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Background

As many backpackers know, silicone impregnated nylon, now commonly used in outdoor product applications, actually began life in the early 1990's as a high performance parachute fabric. The original reasons for infusing silicone into the lightweight nylon base material were primarily to increase its strength and to render it impermeable to air flow. Fortunately for today's hikers, this new material also turned out to be waterproof (more or less), making it an appealing option for use in ultralight tarps, tents, packs, ponchos, stuff sacks, pack covers and the like. Not long after its adoption in the parachute industry, companies such as Integral Designs, Tarptent, Six Moon Designs, Oware, Equinox, and others began offering products constructed mostly from the "standard" version of silnylon that typically uses a 30 (or sometimes 40) denier ripstop nylon as a base fabric and that weighs approximately 1.3 ounces per square yard after silicone impregnation.

In addition to the standard weight version, silnylon is also available in both lighter and heavier versions that are optimized for specific applications. Likewise, other base materials, such as microfiber polyesters and even cotton, can be infused either with silicone or with polymers such as polyurethane or melamine derivatives, to create finished fabrics whose uses overlap with those of standard silnylon and that can now be found in products ranging from hot air balloon canopies to racing yacht sails. Despite the existence of these similar fabrics, however, standard weight silnylon's unique combination of properties has caused it to emerge as a favored choice for use in the ultralight floored tents that are the primary focus of this article.

Looking forward, 30D silnylon's dominance could be challenged by DuPont's introduction last year of a silicone impregnated Cordura fabric that is said to be both stronger and lighter than standard weight silnylon. This new fabric is now being used by companies such as Granite Gear in a line of ultralight stuff sacks and by Sea to Summit (an Australian company) as a canopy fabric for its trekking umbrellas. Its suitability for lightweight shelters, however, remains to be seen and may ultimately depend upon legal considerations. One of silnylon's problems (which probably applies to SilCordura as well) is its flammability, a property that creates compliance issues with the tent fabric safety laws in some jurisdictions. Fire-retardant versions of silnylon may become available at some point in the future, but it's my understanding that no mills produce such a fabric today.

Tent Floor Problems

When used as a canopy material for ultralight shelters, 30D silnylon can work quite well (at least initially). It has a high tear strength for its weight and is waterproof enough to repel all but the most robust rains (which can sometimes penetrate the thin fabric creating a light "misting effect" inside a shelter). When used for tent floors, however, this fabric suffers from the disadvantages discussed below when compared with the polyurethane-coated nylons that have traditionally been employed for this purpose.

The motivation for this sub-optimal materials selection is simple: weight reduction. The ultralight segment of the tent market, and perhaps to a lesser extent the mainstream tent market, currently seems to be driven almost as much by weight factors as it is by features and functionality. Though the ultimate weights of alternative floor fabrics in most real-world products may not be that far apart, differences of only a few ounces can nonetheless be important to many customers.

> **Example:** The optional sewn-in floor of the popular Tarptent Squall ultralight shelter is constructed from standard silnylon and weighs about 5½ ounces, according to the manufacturer. If it were constructed from even a light version of a traditional polyurethane-coated ripstop nylon fabric (70D, 6,000mm), the weight of the floor would be about 11½ ounces. Though not immense, the 6 ounce weight difference can still be non-trivial in this highly competitive market.

Unfortunately, though lighter in weight than traditional materials, 30D silnylon, when used as a flooring material, suffers from three significant problems:

- **Problem #1:** The first thing most ultralight shelter buyers notice about silnylon floors is their extreme "slipperiness". If a tent with such a floor is pitched on even a slight incline, occupants can quickly find themselves and their gear sliding into the downhill walls. Besides being annoying and uncomfortable for users, this concentration of weight is also hard on the tents since it can create a fair amount of extra stress on floor seams and stake-out loops, especially on the uphill sides. Ironically, when considered in connection with the tent's canopy, silnylon's slipperiness can be an advantage since it helps, for example, accumulating snow to slide off the roof and onto the ground, reducing strain on the structure.

  Some ultralight tent manufacturers have suggested solving this problem by painting stripes of silicone sealer on the inside surface of the silnylon floor, but if you've tried this procedure, you already know that it doesn't work very well. Since most of the silnylon remains exposed, the fabric will usually continue to slip and slide against both objects inside the shelter as well as against the ground beneath.

- **Problem #2:** Standard silnylon is waterproof, but only to a limited degree. Any "waterproof" fabric will eventually leak if enough pressure is applied either to the water that's attempting to penetrate from the outside, or to the dry inside surface of a fabric that's pressing against an external layer of moisture (the case, for example, with a tent floor). A fabric's water resistance is usually gauged with a device such as this that's used to measure a property known as the "hydrostatic head". This factor reflects the maximum amount of pressure that a fabric can withstand before it begins to leak and is commonly expressed either as the height of the water column (usually in millimeters), or as the number of pounds per square inch of water pressure necessary to force that leakage.

  The polyurethane-coated nylon fabrics used to construct the floors of conventional tents typically have hydrostatic head values that range from 5,000mm to 10,000mm for reasons that are noted in the next paragraph. In contrast, the hydrostatic head of standard weight silnylon, according to most manufacturers' specifications, is only 1 to 2 pounds per square inch, which translates (for consistency with industry conventions) into a range of 700mm to 1,400mm. In other words, standard weight silnylon, on average, is less than 15% as water resistant as conventional tent floors. And that's when new. My own testing suggests that water resistance can deteriorate significantly with use, findings that are in line with the parachute industry's acknowledgement that silnylon typically becomes much more air-permeable with the stresses of usage over time (mandating the eventual retirement of silnylon parachutes for safety reasons).

  So why does this matter? Well, when a backpacker sits on a tent floor, most of his/her body weight is concentrated onto a relatively small area. If a 180 pound man, for example, is in a "knees-up" sitting position, as much as 90% of his total body weight (or about 160 pounds) is distributed across perhaps 25 square inches of "butt print". The man is therefore exerting about 6½ pounds per square inch of weight (or the equivalent of 4,550mm of hydrostatic head force) against a fabric whose water resistance is, at most, 1 to 2 pounds per square inch. Practically speaking then, if a tent floor made from standard weight silnylon is the only barrier between the man and a soggy patch of ground beneath, water will probably be forced through the fabric. These concentrated occupant forces are also the reason that the hydrostatic head values of conventional tent floor fabrics have traditionally been 5,000mm or higher.

- **Problem #3:** With a thickness of only about 1½ mils (1 mil = .001 inch), standard silnylon is pretty thin stuff, a fact that can limit its durability when used in direct contact with the ground. It is, in fact, particularly susceptible to micro-punctures and fiber stress fractures when body weight is applied to the top surface. The degree to which these injuries actually occur depends, to a large extent, on the kind of surface upon which a tent is pitched. Soft forest duff is fairly easy on floors as long as sites are preened for sharp obstacles. On the other hand, hard-packed earth that's covered with a layer of tiny pebbles (like the soil, for example, that's commonly found at higher elevations in the Sierras), is particularly hard on tent floors.

  Floor deterioration on these kinds of surfaces is sometimes described in the backpacking literature as "abrasion", which suggests a kind of wear that's caused by a shearing movement of the floor against the ground surface. In fact, however, little or no movement of the floor is usually required to quickly produce damage with silnylon. The 6½ pounds per square inch of body force noted above is more than enough to push the sharp edges of surface gravel well into, or even all the way through, the thin fabric. Even if not completely punctured, the fabric will likely be weakened enough to significantly reduce its water resistance.

  If you'd like to test this phenomenon at home, your cement garage floor is a good place for an experiment, since it's almost inevitably littered with some of these tiny rocks. If you have a scrap piece of silnylon, place it onto the hard floor, then sit on it for a bit. You'll find that it doesn't take much effort to damage the fabric. For these reasons, the use of a ground cloth under your silnylon tent floor (perhaps even if you apply the treatment described below) can make sense, especially if you know that you'll be camping on hard-packed soils.

Treatment Description

The silicone that's used for impregnating ripstop nylon fabrics becomes quite inert, chemically speaking, when it's fully cured. As a result, few substances, other than adhesives that are themselves silicone-based, will actually bond to silnylon. The process described below, therefore, uses a silicone sealant as a foundation that's then diluted with a petroleum solvent (mineral spirits) to form a slurry that can be painted onto one, or preferably both, side(s) of a silnylon tent floor or ground cloth. This recipe is similar to those that have been used for several years to create do-it-yourself silnylon seam sealers, but with a few important refinements.

The primary key to success with this treatment is getting the dilution right. I've tested mixes ranging from 1:1 (sealant-to-solvent by weight) to 1:15 and believe that a mix of about 1:3 is probably optimal for tent floors. Adding more sealant simply adds more weight without significantly improving the quality of the treatment. Adding more solvent, on the other hand, quickly thins the slurry to a point where the treatment fails to accomplish the objectives. The only practical way to make sure that the mix is correct is to weigh the components, so the use of a scale in the process is critical.

PROBLEMS SOLVED

When applied as described, this treatment is colorless, odorless and quite durable. It will also:

1. Completely eliminate the slipperiness of the original silnylon. The treated material will have a new "rubbery" feel that will grip both ground surfaces under the tent, as well as sleeping mats and other gear inside the shelter even better than traditional polyurethane floors.

2. Substantially enhance the water resistance of the treated surfaces. Though the home-grown apparatus and procedures I used for my hydrostatic head tests (and that will be described in greater length in the upcoming article) are admittedly somewhat crude, they suggest that if applied evenly to both sides, the treatment can transform standard 30D silnylon into a floor fabric that's about as waterproof as those with traditional 6,000mm polyurethane coatings (i.e., an increase in water resistance of 5 to 7 times).

3. Approximately double the effective thickness of standard weight silnylon from 1½ mils to about 3 mils. The new layers of protection on either side of the fabric, along with the ability of their rubbery surfaces to absorb minor environmental insults without sustaining serious damage, can significantly improve the resistance of treated surfaces to punctures and other stress wounds.

WEIGHT

Aside from the small cost of materials and the time required for application, about the only downside to the treatment is that it adds a little weight to the tent. If applied to both the upper and lower surfaces (recommended), the floor will probably become 2 or 3 ounces heavier as the silnylon fabric gains about ¾ ounce per square yard. Accordingly, the new fabric weight will be approximately 2 ounces per square yard, rather than the original 1.3 ounces. Even at this weight, however, the treated floor will still be lighter than most 70D polyurethane-coated fabrics by 25% or more. In addition, some users will probably decide that their silnylon floors are now sufficiently "trail hardened" that it's no longer necessary to carry separate ground cloths to protect them, thereby saving the weight of the coating and then some.

OTHER ADVANTAGES

In addition to solving the three primary problems noted above, the finished floors will enjoy a couple of other advantages over their conventional polyurethane-coated brethren:

- When exposed to moisture, a silnylon floor (whether treated or not) will typically absorb much less water than a traditional floor. That's the case because polyurethane coatings are usually applied only to inside surfaces, which means that the uncoated, hydrophilic (water loving) nylon fibers on the outside are free to soak up as much water as they can carry. That tends to be true (in my experience) even if a durable water repellant (DWR) is initially applied to the outside surface, since these repellants often wear off tent floors quickly with use. From a practical point of view, although the absorbed moisture may not actually penetrate the polyurethane floor while the tent is pitched in camp, it will add weight on the trail.

- Over time, polyurethane coatings can sometimes peel away from the nylon base fabrics or otherwise become damaged with use. Since the polyurethane coating process is not generally considered to be user-friendly, tents with these afflictions must often be returned to the factory for repairs. The treatment described here, however, can be easily re-applied (in whole or in part) whenever necessary.

All factors considered, and after a year and a half of testing, the bottom line for me is that I now much prefer a silnylon tent floor that's been treated with the process described here over a conventional, polyurethane-coated floor.

Key Ingredients

Primary materials required (+)

The key ingredients required for this process are simple and inexpensive. They include:

- A tube of clear, general-purpose silicone sealant. You'll need at least 2½ to 3 fluid ounces, or possibly more, depending on your floor size. Almost any brand will do, but you'll probably find that the ubiquitous GE products, at about $1.00 per fluid ounce, are more expense than most others. In contrast, the 10.1oz Mainstays brand that's currently sold in caulking tube form at Wal-Mart for $2.17 (pictured above) works well and costs only about 20% as much. Its packaging is also transparent on one side, so that it's easy to see how much sealant has been used (why don't all manufacturers do this?). If you select this option, you'll also need a caulking gun ($1.54 at Wal-Mart) and a nail or similar object to plug the partially-used caulking tube after use.

  Important: For this ingredient, make sure that you use a true silicone sealant. There are other clear adhesives that have a similar appearance, but that are not actually silicone-based. These other products will not work for this treatment, so make sure that you read labels carefully.

- A quart of low-odor mineral spirits (sometimes called "Stoddard solvent"). Mineral spirits is a general purpose, petroleum-based solvent that's normally used as a paint thinner. The Kleen-Strip brand is currently sold in Wal-Mart's paint department for $3.17 and may come either in a metal can (pictured above) or a clear plastic bottle.

  Mineral spirits is also available in a traditional formula (I guess I'd call it "high-odor") that you want to avoid. Besides being unpleasant to work with, this type will also impart a strong petroleum smell to the finished treatment that will take a long time (many weeks) to dissipate.

  Important: So to repeat, make sure you use low-odor (sometimes called "odorless") mineral spirits. This version costs a dollar or two more per quart than the older formula, but is well worth the extra expense for this treatment.

- A metal can (16 oz to 32 oz) for mixing the ingredients. Some plastic containers may be OK too, but it's also possible that the mineral spirits could react with certain polymers, so a metal container is probably the safest choice. You may also need a second container for cleaning your brush and/or for disposing of excess slurry.

- Something with which to stir the ingredients. A hardware store wooden paint paddle (often free) split vertically into 2 strips with a box-cutter works great.

- A paint brush, 1½" to 2" wide, to spread the slurry mix onto your tent floor surfaces. You'll want to make sure that the brush is OK to use with oil-based paints so that the mineral spirits won't dissolve the bristles. A foam brush that's oil-base safe might also work, though I haven't tried it myself. Don't spend a lot on this brush, however, since you'll probably end up discarding it.

- A scale that's reasonably accurate in the 0-to-5 pound range. I use a postage scale (pictured above) that handles up to 2 pounds. Most kitchen food scales also work well. If you're an ultralight backpacker, then I suspect that you probably already have a suitable option at hand.

- A supply of paper towels.

- And finally, you'll need a tarp or reasonably thick painting drop cloth that's large enough to place under your tent for protection while you apply the treatment. During the process, you'll probably need to get on your hands and knees on top of the fabric in order to reach the areas you wish to coat. If you place your tent directly on say, a garage floor, you could end up micro-puncturing the canopy with the tiny particles of gravel that are described above.

Treatment Process

Note: If you're uncertain about this process, you may wish to test it first on a scrap piece of silnylon or on a small section of your tent floor before committing to covering an entire surface. Small quantities of silnylon that can be used for testing purposes are available from a number of online sources, including those mentioned here.

Step 1: Prepare your tent floor to be painted. To coat the interior side, it may be easiest to set up the tent as you normally would on reasonably firm ground, with a tarp or ground cloth underneath to protect the floor from punctures. Alternatively, you can turn the tent inside out through the doorway to expose the interior floor that can then be laid out flat on your work surface for coating (again, making sure there's a tarp beneath to protect it). This same approach can also be used to coat the exterior surface if it's not possible to pitch the tent inside out. And of course, make sure that the surface about to be painted is clean and dry, and that the work area is well ventilated.

Step 2: Mix your first batch of slurry. To do so, first place your empty mixing container on the scale, then adjust the weight (probably using a knob located somewhere on the scale) back to zero. Now squeeze 1 ounce of silicone sealant into the bottom of the can. Re-adjust the total scale weight back to zero again, then add 3 ounces (by weight) of mineral spirits. Finally, stir the sealant until it's completely dissolved in the mineral spirits. This process can take quite a while - perhaps 3 or 4 minutes or more, since the sealant tends to dissolve slowly. Keep stirring though, until the mix is uniformly runny.

> **TIPS:** It's best not to mix too much slurry at one time, since it can begin to cure (dry) in the can before you have time to paint it onto the fabric. If you're treating a relatively large surface, you can mix additional batches as necessary. Also, if your scale can't be re-adjusted to zero as described above (a convenience, but not a necessity), you can simply add the weights of each component to the cumulative weight up to that point in order to maintain the right mix.

Step 3: Using your brush, paint the surface of the fabric in sections, as evenly as possible, using overlapping strokes. Most floors will probably require only 10 or 15 minutes to cover completely. When you're finished with the first side, clean any excess slurry out of your mixing container and dispose of it. You can then rinse your brush with mineral spirits to clean. The new treated surface will probably be dry enough to touch or to move in 30 to 45 minutes. To be safe, however, it's probably best to allow the first surface to cure overnight before turning your tent inside out and coating the opposite surface.

> **TIPS:** If you use a caulking gun for the sealant, use a nail or similar object to stopper the partially-used tube after painting sessions. It's also best to remove the tube from the gun, since it's sometimes possible for sealant to squeeze backwards into the chamber around the gun's plunger. When it cures, this "blow-back" sealant can effectively freeze the tube into the gun, making the two components very difficult to separate from one another.

Step 4: When you and your tent are both ready, repeat steps 1 to 3 for the second surface. One coat on each side will probably be sufficient as long as a 1:3 mix ratio is maintained.

Other Notes

- The treatment described here could, of course, be used to enhance the water resistance of other silnylon products. Stuff sacks are one possibility that come to mind, though you'd probably want to limit the treatment to the outside surface only, since the high "friction factor" of the coating might make it difficult to get things in and out of the sack if the interior were treated.
- If your tent floor is subjected to a lot of use on gravel or other abrasive surfaces, you may find it necessary to re-coat the floor at some point. To minimize the cumulative weight impact of the treatments, you could probably get by painting just the high-wear portions of the floor, and/or by using a slightly more diluted solution (perhaps 1:5). I haven't tried re-treatment myself, however, so you're kind of on your own here.
- If you happen to build your own shelters and are wondering if you should treat the floor before or after it's sewn into the tent, you might want to know that, at least with my machine (a Brother model XR-46 without a walking foot), the post-treated fabric feeds through the machine with no problems, making possible the more convenient option of treating-before-sewing.
- To the best of my knowledge, this process (at least using these ingredients) only works well on silnylon. If applied to other fabrics, the treatment will usually rub off with little effort.
- Even with this treatment, you still may elect to use a ground cloth under your tent floor, if only to help keep it clean. While there are plenty of options out there, I've had particularly good luck with kite Tyvek (Type #1443R). At 1.25 oz per square yard, it weighs even less than standard silnylon, is quite tough, not slippery, and fairly water resistant (though not completely waterproof). More information about its properties and availability can be found here.

  And as you probably already know, any ground cloth should be slightly smaller than your tent's footprint so that exposed edges don't channel rain under the floor. This advice only works, however, if the ground cloth remains more or less centered under the tent. To help keep it in that position (especially under high wind conditions) I'd recommend attaching lightweight cord loops of an appropriate length to each of the ground cloth's corners (Kelty Triptease or nylon parachute cord both work well for this purpose). These loops can then be hooked onto to the tent's existing stakes to anchor the ground cloth in place. With kite Tyvek or other lightweight fabrics, the strongest way to attach these cord loops is probably to tie them (rather than sew them) into the fabric using a knot of your choice.

In the spirit of collaboration with your fellow backpackers, if you try this treatment, please let us know about your experiences through the feedback forum. Your comments and suggestions will undoubtedly help to improve the process for everyone... Thanks, Jim Wood.

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