Not all varnish labeled as "marine varnish" or "spar varnish" is suitable for exterior applications..

Marine Varnish
(a.k.a. "Spar Varnish")

There is a persistent myth that marine varnish (a.k.a. spar varnish) is somehow harder, stronger, and more resistant to moisture and other *hazards* than other types of varnish. Aside from the fact that this is simply not true, any discussion of marine or spar varnish must begin with the understanding that not all varnish products advertised as "spar varnish" are the same; nor do they offer the same quality. There are products on the market advertised as "spar varnish" that give a whole new meaning to the term "inferior". Not only do these products fail to perform as advertised; but, it is questionable whether they should be used in any but the most protected exterior applications.

Before we separate the real marine varnishes from the pretenders, let's take a few moments to understand why marine (a.k.a. spar varnish) was developed; and, to understand the environment in which marine varnishes are intended to be used. The requirements placed on a marine varnish are quite different than those assigned to varnish used in interior applications. Therefore, in order to properly perform their intended task, quality marine varnishes are formulated differently than other varnish types.

Marine varnish is a niche product—quality marine varnishes do an excellent job in their intended application. But, like many specialty products, when called upon to perform outside their design parameters, they are less than satisfactory. We are given a clue to the intended application of these products by the name "spar varnish". The word *spar* refers broadly to the elements in the rigging of a sailing ship that support the sails. In the accompanying photo of a sailing ship, the sails are attached to horizontal *spars* called the *yards,* or *yard arms,* which are in turn supported by the masts. It should also be apparent from the picture of a sailing ship cutting through

the sea under full sail that the bending and flexing stresses on these wooden elements is incredible. This simple observation leads us to our first understanding of the requirements placed on a marine or spar varnish by the environment in which the finish must function. The finish film of a marine varnish must be able to flex and bend; and, it must accommodate both stretching and compression without fracturing or loosing adhesion with the wood. This, in reality, is job one—all other attributes of marine varnish must be secondary to its ability to flex and bend. This property reveals the first critical attribute of marine varnish. By definition, to function properly marine varnish must be what we refer to as "long-oil varnish".

Varnish is made by cooking a resin or combination of resins with one of the drying or semi-drying oils in a controlled environment so that the molecules of oil and resin join in a process called cross-linking. This re-alignment of molecules produces a new molecular structure that we call varnish. The resulting varnish is then thinned with mineral spirits making it easier to apply. When the varnish is applied the thinner evaporates and the molecules of varnish react with oxygen in the air (polymerize). When the curing process is complete we are left with a finish film. (Click here for some additional reading on the manufacture of varnish.)

A long-oil varnish is simply varnish in which more oil is used, relative to the amount of resin, in its formulation. When more oil is included in the formulation (the varnish is "long" on oil) the properties of the resulting varnish film will reflect the impact of the added oil. The most significant contribution of the added oil is to make the varnish softer and more flexible. The finish film of a long-oil varnish will flex without fracturing. While the added oil produces a finish film that is more flexible it carries with it some attributes that are less desirable in non-marine applications, not the least of which is a finish film that is significantly less resistant to abrasion, heat, solvents, and moisture. It is on this last point, reduced moisture resistance, that we encounter the second major misunderstanding about marine varnish (the first being its perceived hardness). The added oil used in the production of marine varnish (according to tests conducted by the US Forest Service, Forest Products Laboratory) results in a reduction in the Moisture Excluding Efficiency (MEE) by over 30% when compared to varnish with a lower oil content. So, marine varnish achieves its improved flexibility at the expense of *both* hardness and moisture resistance. As you will see later, these reductions impact the choice of marine varnish in applications not suited to its formulation.

With this as a background let us now consider those elements that go into the formulation of higher quality marine varnishes. Varnish made from any oil can be turned into a long-oil varnish by simply including more oil relative to the amount of resin employed in its manufacturer. However, the higher quality marine varnishes are virtually always made from tung oil and phenolic resin. Tung oil because it provides one more site on its molecular chain to which other molecules can link; and, phe-

nolic resin because it is the hardest of the resins commonly used in the formulation of varnish. Neither of these attributes result in marine varnish with the same hardness and moisture resistance of regular-oil varnish or short-oil varnish; but, they do provide the best combination of flexibility, hardness, and moisture resistance possible in a long-oil varnish.

Higher quality marine varnishes are also formulated to resist damaging UV rays caused by direct exposure to sun light. On this point it is commonly assumed that UV resistance is achieved by the addition of UV inhibitors. While many of these products do contain UV inhibitors, the better marine varnishes do not. They rely instead on the high reflectivity of a gloss sheen. … The nature of the finish film to deflect the damaging rays of the sun. This property places a much higher premium on regular maintenance to maintain the finish. To illustrate, if you know (or are) a wooden boat owner you are probably acquainted with the annual ritual of scraping, sanding and refinishing. Even those marine varnishes that contain UV inhibitors require annual maintenance since these inhibitors are consumed in the course of protecting the finish from the destructive effects of UV, so the finish must be renewed frequently to retain UV protection.

Now, let’s take a look at the marine varnish pretenders—the so-called "spar varnish" made from linseed oil and urethane resin. "Spar Urethane" varnish should be avoided in any exterior application in which even moderate exposure to direct sunlight is likely. We need look no further than the properties of varnish made from urethane resin (polyurethane) to understand why. Urethane resin varnishes suffer two weaknesses that have direct bearing on varnish used in exterior applications in general, and marine applications in particular.

First, urethane resin is highly subject to UV damage. Polyurethane will begin to yellow, develop hair-line cracks, and loose adhesion with the wood very quickly in a full-sun environment. Soon thereafter it will begin to flake and peel from the surface. The more popular spar urethane varnishes can be expected to completely fail in as little as a single season in a full-sun environment. Even in moderate sun they are likely to last no more than a couple of seasons.

Second, urethane resin varnish exhibits poor adhesion when compared to other varnish types. The initial coat does not penetrate into the cell structure of the wood as well as other varnish types; and, subsequent coats do not adhere as well to previous coats without thorough sanding between coats. Further, during annual maintenance when damaged areas are sanded and a new coat of varnish is applied, polyurethane fails to adhere well to the previously applied and fully cured coats, even when those coats are aggressively sanded. Poor adhesion between coats, itself not a good thing, also result in a finish film that lacks flexibility.

When used in a marine application, varnish must exhibit some very specific properties. The varnish must be flexible so it will not fracture when the finished surface flexes and twists. It must also offer

sufficient UV protection to protect the finish and the finished surface from the damaging rays of the sun. Further, marine varnishes must exhibit excellent adhesion properties since regular maintenance will require that these finishes be sanded and re-coated periodically to maintain their integrity. The properties of quality marine varnishes make them the finish of choice in a marine environment—the environment in which they were developed to function. These same properties are not well suited to applications in which a harder more abrasion resistant finish film is indicated, nor should marine varnish be employed in applications where resistance to household chemicals, solvents, and moisture are common hazards that the finish film will encounter. Finally, no varnish that contains urethane resin (polyurethane), however it may be marketed by the manufacturer, should be used in a UV rich exterior environment.