December 2003

DIMENSIONS

Newsletter of the Pacific Woodworkers Guild
http://members.shaw.ca/pwwg

Next Meeting:

- Tuesday, Dec. 16th

When Last We Met

by Gordon Bednard

Meeting opened at 7:15 with the announcement that Phil, our leader and guiding spirit (OK, maybe this is a little over the top), was unwell and would not be in attendance. Bob Bedier stepped in and ran the meeting so smoothly one might have thought he had done something like this before.

Not surprisingly, this being the first meeting following the Cloverdale Wood show, a number of new faces were in attendance. These included Stewart, who builds movie sets; Dave Sweet who has too many tools and too little space; Terry Jolly who is in the automotive business and uses woodworking to relax; Ivan Antonio who designs and builds furniture; Bill McKay an aspiring woodworker who is looking to learn; and Dave Kay who has most of the tools and wants to learn more about how to use them.

Bill Ophoff then introduced our guest speaker for the evening: John Davison is an metallurgist and president of Precision Heat Treating, a company which, oddly enough, uses heat to change the properties of metals to make them more useful. This includes all manner of metals for various applications, especially cutting tools for the wood and metal working industries. John spent a good half hour going through the various processes involved in turning different types of metal into useful bits of tooling, much of which was way over the head of your humble scribe. However, he did refer to several metallurgy handbooks, (i.e. the Machinists Handbook) copies of which are available through better bookstores or for reference at the library, and these would likely answer all questions presuming you knew what to ask.

The basics of his presentation went something like this:

- Iron plus carbon makes steel.
- ¼ % carbon makes mild steel, ½ to 1 % makes tool steels, 1% and over makes cast iron
- Various other additives (chrome, nickel, molybdenum) are included to make different grades and properties (hardness, toughness, wear resistance)
- These alloys change the basic structure of the steel which in turn, changes its properties
- Heat treating causes the atoms of the steel, which are in a crystalline structure, to move and align in different patterns based on the temperature reached
- Cooling the metal at different rates imparts different characteristics to the steel (slow cooling softens the material while fast cooling leads to hardening)
- This is related to the migration of the carbon atoms within the structure of the steel as fast cooling does not allow migration and keeps the carbon near the surface where it helps harden the steel
- There are various ways to test for hardness, the most common being the Rockwell scale where typical chisels would be rated at approximately 62. Harder steel would be too brittle and softer steel would wear out edges too soon.

John's business mostly deals with tools for the forest industry, chipper and planer blades especially. He gave some details about the design of the furnace used for heat treating at his plant. Suffice it to say, its big, sophisticated and can heat metals to various temperatures, cool them at various rates and do this all within an inert gas environment to prevent oxidation.
In answer to questions from those assembled John noted that you had to start with the right grade of steel or you could never get the desired result but that even steel

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Please direct newsletter submissions to the newsletter editor,

The Pacific Woodworkers Guild is a non-profit association of British Columbia Craftspeople dedicated to excellence in woodworking. Guild members meet on the third Tuesday of each month (except July and August) in Richmond, B.C.

The newsletter is published monthly, ten times per year, and distributed free to members and associate members. Membership is available to anyone interested in any form of fine woodworking. Membership fees are $25 for twelve months; Associate membership fees (newsletter only) are $15 for ten issues.

Guild Directory

Elected Officers

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Vice-President	Dan Lemire
Treasurer	Lou Hafer
Secretary	Paulin Laberge
Members-at-Large	Paul Townsend
	Bill Fox
	Art Liestman
	Bob Bedier

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	Merv Graham
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	Bill Fox
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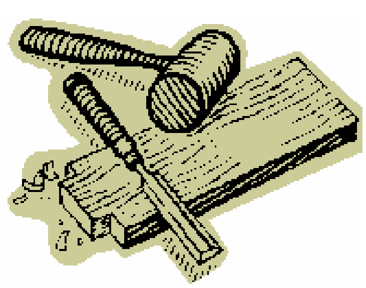
Christmas Toy Workshop	Denis Reid
Assistant	Dave Adshead
Fundraising/Raffle	Steve Wegwitz
Assistant	Bill Fox
Library	Bob Bedier

Next Meeting

The next meeting of the Pacific Woodworkers Guild will be held on Tuesday, December 16th starting at 7:15pm. Pre-meeting demo at 6:30.

Guest Speaker—Mary Chinni. Mary has worked in the wooden boat industry for many years and has trained quite a few people in her topic of applying a varnish finish.

President's Challenge—A nutcracker of any design



When Last We Met (con't)

from trailer springs could be made into tools if it was treated right.

Following the presentation coffee and goodies (an exemplary spread of tasty comestibles) was enjoyed by all. (Thanks Bill!)

Meanwhile, back at the business meeting:

Kelly McClay made a brief presentation and wrap-up of the wood show stating that thing generally went well and it was a good show. He also asked for comments and other input which would go into a report for the next year's wood show liaison. Special thanks went to Hugh McGillivray for all his work.

Rob Prinse was looking for volunteers to travel with and operate the belt sander track at the other western Canada wood shows next year. Response to the request were non-existent and a movement appeared to be afoot to sell the track to the wood show people if they were interested.

The president's challenge for December was decided to be "nutcrackers of any design" which should give the members a lot of scope to use their imagination.

It was suggested that the members should bring all manner of goodies to the December meeting, a suggestion which seemed to have huge support with Steve Hansen even suggesting "Rum Punch". Your scribe is uncertain if this suggestion went as far as Steve providing said punch.

In response to Steve Hansen's e-mail about scribes for the meetings, the following persons offered to perform this essential service: Marco, Bill, Paul, Ivan (one of the new guys!!) and Bob. This would get us well into the new year, with hopefully more volunteers coming forward in relief. This was to be brought up at the December meeting. As well, on the subject of the newsletter, articles, photos, questions for the editor, etc. would be appreciated.

For the benefit of the new people present, Bob Bedier briefly went over the rules for the 2 X 4 challenge and invited their participation. The theme this year is "Something made of wood that no longer is." You don't have to stick to the theme, but you will get bonus points if your entry does.

Congratulations from the Guild were extended to Steve Hansen for his third place finish in the recent wood turning competition held at the wood show. Raffle sales at the show netted a rather poor $637.00.

We are just now finalizing the Guild's membership in the Wood Co-op on Granville Island – contact Steve H. if you are interested in exhibiting. Apparently the Co-op charges a 43% commission on sales. As well, a second galley/outlet is being planned for the Co-op – stay tuned.

Show and Tell featured a turned "beehive" vessel finished in airbrushed lacquer by Marco, and a specially curved sanding block designed to smooth the curve of a large table leg built by Rob Prinse.

Late thoughts: Denis Reid, who has been head manning the toy workshop lo these many years, would like to hand over the reigns starting next year. Everyone knows this is a worthwhile project of the Guild and should think about leading this rewarding effort into the future. A volunteer will be called for at the December meeting.

Meeting adjourned at 9:15

Metallurgy Demystified: A Buyer's Guide To Tools

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"higher prices are not always proportional to higher quality"

What It's All About

While Taiwanese tool manufacturers tout the advantages of high-carbon steel, North American suppliers are often silent about the merits of the far superior high-speed steel. Without adequate information, the unsuspecting woodworker must rely upon the promotional "facts" that manufacturers use to sell their products. The truth about the composition of a tool is not always clearly stated. For example, high-speed steel often has the same amount of carbon as high-carbon steel. And high-speed steels often contain molybdenum or tungsten as their principal alloying element, the same ingredient used in carbide tools.

As you know, higher prices are not always proportional to higher quality. So, rather than purchasing the next tool for which carbide becomes the material of choice, find out which type of a specific tool best fits your needs. To do so, you have to understand a little bit about metallurgy.

All cutting tools can cut materials of a lesser hardness - for a while. Some cutting edges stand up longer than others. This is due to a number of factors other than absolute hardness. Properties such as heat resistance, shock resistance, toughness, hardness and red hardness all affect the durability of a tool.

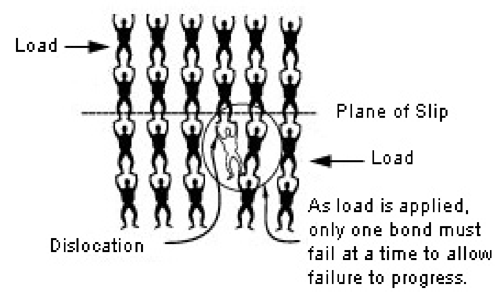
Alloying elements – carbon, nickel, chromium, vanadium, molybdenum and tungsten - affect these attributes in a variety of ways. These elements, when used in isolation or in conjunction with one another, alter the cutting characteristics. But before listing the characteristics of each of these alloys, it is important to understand how a metal behaves under load and why.

Dislocation Theory (or, Why Steel Isn't Mush)

As a metal cools, small particles form in the liquid, and eventually crystals develop in a regular, 3-D geometric pattern. But because the particles solidify randomly throughout the liquid, the crystals or grains will eventually obstruct one another and form grain boundaries. The atoms at the grain boundaries are not as well bonded to their neighbours as they are to others within the same crystal or grain.

Usually there are many breaks (called dislocations) in the neat atomic structure, which allow the atomic bonds to break in a progressive manner, each at very low forces, rather than simultaneously.

Solid metal doesn't become mush because the many dislocation lines interact with one another, impeding the progression of each dislocation. Moreover, since the slip planes of neighbouring crystals are rarely in exact orientation with one another, a dislocation is also stopped by a grain boundary. So, the greater the number of crystals in a given area, the greater the strength, hardness and impact resistance, all resulting in higher



toughness. The promotion of fine grain size is one of the most important factors influencing toughness.

What Exactly Do All Those Elements Do?

Carbon

Carbon, added to all steels, increases hardness (though at the expense of ductility). No cutting tools are made of low-carbon steel (less than 0.3% carbon), as there would be insufficient carbon to allow hardening to any significant degree. Medium-carbon steel (0.3 to 0.6% carbon) possesses increased hardenability and toughness. High-carbon steel (0.6 to 1.2% carbon) has very good wear resistance and hardenability, but is not as tough as carbon steel with lower carbon contents. Toughness is necessary when, for instance, a drill bit encounters a hard pin knot. A high-carbon steel drill bit will have reasonable longevity between sharpenings, but if its cutting edge encounters an abrupt change in

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the material, it is likely to fail at that contact point.

Another drawback of high-carbon steel tools is their inability to hold an edge at elevated temperatures. Beyond 400°F, high-carbon steel begins to lose its hardness. The tips of cutting edges are often subjected to such temperatures, and once their hardness is lost, the edge breaks down in ductile failure.

Nickel (Ni)
Nickel increases toughness and impact resistance, while reducing the tendency to distort as the material is quenched during the hardening process.

"All cutting tools can cut materials of a lesser hardness - for a while"

Vanadium (V)
Vanadium is another alloying material that forms strong carbides. These carbides do not readily disperse into the molten steel, so as solidification progresses, grain growth is inhibited.

Chromium (Cr)
Chromium, when added to steel during the manufacturing process, joins with carbon to form chromium carbides. This increases the material's ability to harden, as well as its abrasion and wear resistance.

Molybdenum (Mo)
Like chromium, molybdenum joins with carbon to form stable carbides but resists grain growth at elevated temperatures. Consequently, fine grain size is retained. It is resistant to tempering, and promotes exceptional toughness. Although molybdenum is not as good as tungsten at promoting red hardness at very high temperatures, it costs less, and is adequate for less extreme temperatures.

Tungsten (W)
Tungsten is very effective at promoting the formation of stable carbides at high temperatures. When the tungsten content is more than 18%, and when it is combined with lesser percentage of chromium and vanadium, the most common formulation of high-speed steel is formed.

Such steel is made by conventional processes (melting the mixture). However, if a material can be made without some of the softer binding agents, such as iron, a greater concentration of the harder alloying elements is possible. This is how carbide, or as it is more correctly (and aptly) named, "cemented carbide" is made.

To produce tungsten carbide, tungsten powder is mixed with carbon at a ratio of approximately 94% to 6%. Small amounts of cobalt are then added, which will act as the binding element. When this powdered mixture is held under high pressures and temperatures (about 2500°F), tungsten carbide is formed, held together in a matrix of cobalt. The result is an extremely hard, but brittle, cutting material. Provided sudden shocks can be avoided, failure occurs most frequently when the lower-melting cobalt wears away, exposing poorly held carbide particles, which are apt to break off. The higher melting temperatures of tantalum and titanium make them more suitable as binding elements. They form "tantalum carbide" and "titanium carbide", which cost more.

Coated Carbide
Coated carbide is a recent development and is produced by a very thin application of an even harder and extremely brittle alloy, to any grade of carbide. Titanium Nitride or "TIN" coating as it is often called, is the most popular hard coating, and is easily recognized by its gold color. This vapour deposition coating is so hard that it can only be applied .0002 to .0003" thick, otherwise it would fracture within itself. It must also be supported by a tougher, but very hard material, such as carbide. It is the combination of the extremely hard, thin coating, plus the substrate's ability to provide the required toughness, that makes TIN coated tools effective. The only drawback (besides the added cost) is that it is removed at the first resharpening.

Alloying Elements and Properties: What Tools Need What?

The commonly used woodworking tools listed below are grouped with other tools that have similar property requirements at their cutting edges.

Chisels, Plane Blades and Carving Tools
Because the cutting edges of these tools often form acute angles (15 degrees to 30 degrees), they must possess a high degree of toughness. These tools must be able to hold an edge over long use, but the keen

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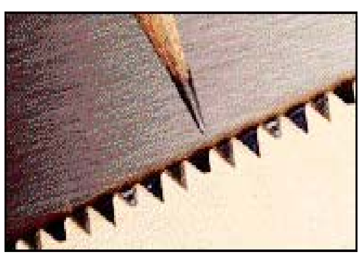
edge must also resist fracturing under wide ranging loads. High carbon steel is the minimum requirement for these tools. Chromium or vanadium are used most often to increase toughness (some blades proudly bear a "Cr-V" stamp). Increased roughness is necessary in low-angle plane blades (as they have less material supporting the cutting edge), and on higher-angled mortise chisels (which are subjected to repeated blows). The addition of molybdenum increases toughness even further.

"Japanese pull-stroke saws usually have harder teeth than western saws"

This alloying element is most often found in automotive tools under such names as "Molychrome". High-speed steels (and other tool steels) are the best for tools of this category, as they can be hardened to Rc 60-64 (Rockwell C scale), and still possess exceptional toughness. While carbide is even harder than high-speed steels (typically Rc 72 and up), it does not posses sufficient toughness at the low angles that this category of tools requires, and will fail in a brittle manner.

Saws and Cabinet Scrapers

These tools must posses a high degree of hardness, as well as ductility, and so are made almost exclusively of medium to high-carbon steel (or "spring steel"). Any alloying elements other than carbon reduce ductility to the point where the blade may snap if bowed (intentionally, as a cabinet scraper is, or inadvertently, as can happen when a western push-stroke saw is forced). In general, for these types of tools, the harder the steel, the better. For example, cabinet scrapers made from high-carbon steel typically range form Rc 38 to 52. The harder scrapers require more effort to burnish a hook, but it will also last longer.

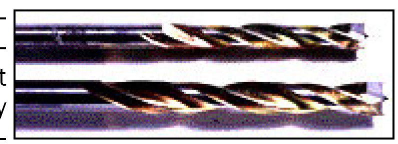


Because western saws cut on the push stroke, the teeth must posses both hardness and ductility, so the blade will not snap when inadvertently bowed. Traditional Japanese saws cut on the pull stroke; if binding occurs, it will be while the blade is in tension, eliminating the possibility of bending. Thus, Japanese pull-stroke saws usually have harder teeth than western saws.

Western-style saw manufacturers now offer induction or impulse-hardened teeth. During the induction process, only the teeth are hardened to a very high degree. The tempered steel comprising the rest of the saw blade provided the toughness. Such blades exhibit a tell-tale gray or black line running the length of the blade, from the tip of the teeth to just behind the gullets.

Drill Bits and Power Saw Blades

These tools are available in everything from high-carbon steel to carbide. High-carbon steel drill bits and circular saw blades do not hold up very well to the high impact forces and temperatures to which they are subject. If you intend to use the bit or blade only once or twice (when an odd drill size is needed, or a saw-tooth pattern to cut a rarely used material), the added cost of high-speed steel or carbide may not be justified. If you are going to buy a drill bit or power saw blade of high-carbon steel, ones that have chromium, vanadium, molybdenum or tungsten are the most practical purchase.



High-speed steel bits and blades have superior toughness and red hardness, which a power tool bit or blade needs. Although not as long lasting as carbide, high-speed steel is less expensive, and can be sharpened by traditional means (e.g., aluminum oxide grinding stones). Carbide can be sharpened only with silicon carbide or diamond stones.

Carbide bits and blades last the longest. Besides their higher cost, they are susceptible to chipping; as hardness increases, toughness is reduced, and the steel becomes more brittle. If a carbide tip hits a nail, that tooth is likely to be damaged beyond repair. A high-speed bit, however, usually escapes with a small fracture, which can be easily

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reground.

With the exception of carbide-tipped masonry bits, carbide-tipped drill bits are not as popular as carbide-tipped circular saw blades. The rim speed of a 1/2" drill bit traveling at 2000 rpm is far lower than the rim speed of a 10 diameter blade traveling at similar rpm. The saw blade encounters much higher forces and temperatures, hence the need for a material that resists both.

Turning Tools
High-speed steel turning tools are favoured over high-carbon steel turning tools because the work hitting the cutting edge of turning tools is moving at speeds equivalent to those of circular saw blades. Carbide-tipped wood turning tools are not very common, although carbide-tipped tools are used almost exclusively in the metal turning industry.

Router Bits
Forget about buying any router bits made of regular carbon steel. At 20,000 to 50,000 rpm, the forces and heat generated would burn a carbon steel bit in an instant. High-speed steel that has sufficient tungsten has improved red hardness, but will not remain sharp as long as carbide will. However, for odd-shaped bits that are used only occasionally (or even once), a high-speed steel router bit may do.

- L.S.
12/93

Explorations In Wood

Call for entries for "Explorations in Wood", a juried exhibition of fine woodwork featuring: furniture, turnings, architectural fixtures, musical instruments, sculpture. The event is presented by the Vancouver Island Woodworkers Guild at the Maltwood Art Museum and Gallery, at The University of Victoria, May 25- August 21, 2004. The entry must include wood presented either as a design or structural element. The jury will consider elegance and originality, functional qualities of design, quality of joinery and finish. Accenting of wood colour and grain will be appraised where applicable.

Awards will be granted for: Best overall work($1000), technical merit($500), artistic merit($500), people's choice($500), peers choice($1000).

Early entry fees: $45 for Guild member, $85 for non-member. The non-member entry fee includes a full membership with the Vancouver Island Guild. A $10 late fee will be added after February 13/04. Deadline is April 16/04. Entrants will be notified as to time and date to deliver their piece's) - usually one week prior to the show. Pieces may be advertised as being for sale but are not sold at the Gallery. Interested clients will just be given the entrant's name and phone number.

While on display, the pieces will be insured by the Maltwood Gallery. Insurance to and from the show is the responsibility of the maker. A maximum of three pieces may be submitted. The show committee may limit entries due to space restrictions.

For more information (entry forms) contact: Michael J. Kattler, 250-380-5025, michaelswoodcraft@shaw.ca

Send applications to: Vancouver Island Woodworkers Guild

Calendar Of Events

- December 16, 2003—Pacific Woodworkers Guild December meeting.
- January 20, 2004—Pacific Woodworkers Guild January meeting.
- February 17, 2004—Pacific Woodworkers Guild February meeting.
- March 16, 2004—Pacific Woodworkers Guild March meeting.
- April 20, 2004—Pacific Woodworkers Guild April meeting.
- May 2004—Richmond Carver's Show
- May 18, 2004—Pacific Woodworkers Guild May meeting.
- June 15, 2004—Pacific Woodworkers Guild June meeting.
- August 2004—Pacific Woodworkers Guild Picnic
- September 21, 2004—Pacific Woodworkers Guild September meeting.