Introduction

Where people are working, accidents can happen. In order to reduce the chance of an accident happening, you can take safety measures. In the process of converting botanical material, bought boards or other wood into an end product, tools are used. Some of these tools can by their very nature, be dangerous. How dangerous? Well, that's mainly up to you, the user. For example, ignoring the instructions for use supplied by the dealer who sold you a product can be very dangerous.

It's a matter of taking the right precautions, having suitable experience, and just knowledge. Even if we can't give customized instructions for use for each separate process, you'll probably benefit from following these guidelines.

As you will see, at a certain point in this reader the remainder of processes when working on the tree you harvested, or on bought boards, will be the same. In case of bought, or delivered, boards, read paragraphs #1 and #2, then go to #12.

Experience has taught us that however alert you may be, the chance of an accident is never reduced to zero. That gives you full responsibility, something you can't transfer on anyone else. Moreover, it's generally yourself that suffers the consequences.

This manual applies to the materials themselves, to the tools you use and to how you use them. General rules like 'never work when you're already tired' and 'don't drink alcohol or use medicines affecting your reaction ability' were not arrived at 'by accident'. Practice has shown that ignoring these rules can be dangerous, not only for you. Following these rules always and everywhere can make a difference -- between a light scratch and an amputated leg; between nothing and badly stubbing your toe, something that's not so dangerous, but you still won't enjoy stubbing your toe. You will note that some sections of this reader are not strictly about safety, but deal with 'best practice'. In many cases, best practice means effectivity, people becoming less tired, enjoying what they do -- so indirectly, best practices promote safety...

Disclaimer

Even if we tried to give you logical, well tried and customary advice and solutions, we are not accountable in case an accident happens to you during the work. These guidelines are meant to improve your safety and reduce hazards; to point out where a false notion of safety occurs; and to let you be convinced you have done your utmost to prevent accidents. We wish you a lot of pleasure working as safely as possible.

Contents

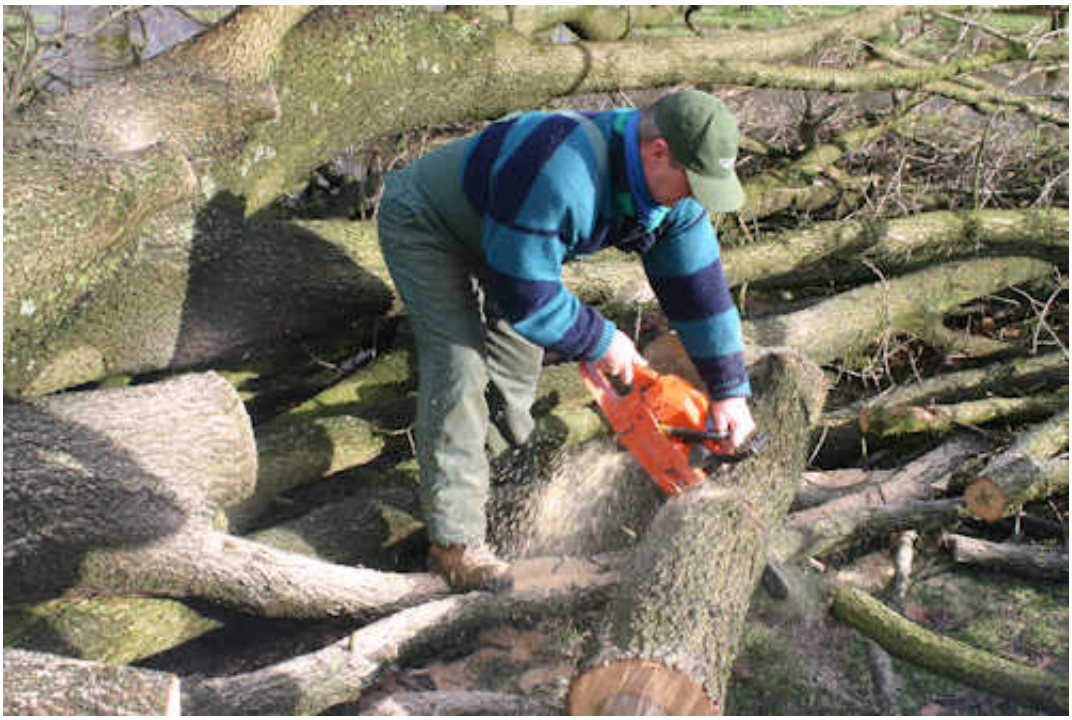
1 Hazards

Hazards, aka **risks** are everywhere in daily life. Life's only guarantee is that, at some point, it will end. Crossing the street, going shopping, a flu epidemic, firing up the stove, a toothache, living in an industrial area, driving a car, riding a public bus -- they all can, in principle, be dangerous. Why don't we panic? We're used to the risks involved. Statistics tell us that most of these activities are not hazardous. We *reduce risks* -- have our car checked regularly, see the dentist every year, sweep your chimney every year. You could define risk as *the chance that something you don't like, happens*. This chance, regrettably, can never be reduced to zero. Note that *insurance does not reduce a risk, only the consequences of accidents*. When you have the flu or suffer a toothache, the doctor or dentist will give you, or do, something to help, but in these cases, the event has already happened and you're **reducing the consequences**, which should be distinguished from **reducing a hazard.**

When you have taken all reasonable precautions against something happening, you have substantially *reduced the chance* of an accident. To reduce this chance to zero, you'd have to suspend *all* your activities. You can't live if you can't breathe; eat; drink; or cross the street; visit your neighbour; go shopping; take a holiday. And of course you could not work. In fact this would be a very quick way to die. Therefore, *chance of an accident happening can never be zero*.

We're used to assess risks in everyday life -- in fact we're so used to it that we do it subconsciously. I bet you never ask yourself what the risks of your everyday activities are, unless you're a smoke jumper, special forces policeman, drugs laws enforcer or, in general, are required to take risks in order to discharge your duties. Everyday risks are usually not that dangerous: being in a traffic jam, waiting in line at the checkout, arriving at an already overcrowded beach or an argument over who uses the coffee machine at work first. In relation to the benefits such as being able to drive to work, getting your shopping done, having a nice swim or drinking coffee, these risks are not so bad. We're used to assess hazards that occur frequently. That's why we don't think a big deal of them. But other hazards are not so harmless.
Lethal accidents can happen, like those associated with drunk driving. They warrant general measures, or laws. Driving while intoxicated, storing explosives unsafely and cooking meth are punishable (a) to deter people from doing this, thereby reducing these hazards and (b) to teach perpetrators not to do it again. The Government in many countries hope, by imposing heavy fines or imprisonment, to make people think again. They try to deter people from such actions, starting from the notion that people *can* think again, *asking themselves whether something is a wise thing to do.* This is where the link to woodworking comes in.
Use of woodworking tools can be a hazard, particularly tools with sharp edges revolving

at high speed. You'd never let a child use such a tool. Would you let a greenhorn use it? No? Why? Because he has no awareness of the dangers. If it's the first time you're doing something, you can't have the experience enabling you to know what to watch for. Hazards of woodworking tools can very well be reduced, but education (starting with the operation manual and being taught on the job) is essential. Planning and preparing can ensure you don't fall into well known traps. Instructions for use generally have a section warning the user of these 'frequent' hazards.
Some accidents are regarded as 'freaks' -- like a lightning strike. There is no sense in forbidding them, same as being hit by a meteorite. Some things are dangerous, but the statistics tell us they are so rare that it makes no sense to take measures (if possible). This reader deals with all *general hazards* we're aware of, and some *less frequent hazards* that could apply. Another point we established is that we only discuss *risks we can reduce within reason*, and are sufficiently severe to warrant measures (they do include that of 'stubbing your toe'. See below what Harry is wearing on his feet).



[*Fig. 1. Use of protection gear. Harry Wissink is wearing a safety suit and safety boots and has supported the part he is bucking. The rough chips indicate his chainsaw is sharpened well.*

2 Parameters

A safe working environment is something that comes into labour contracts. Working conditions should not promote dangers. At work you expect a good level of lighting, ventilation or air conditioning and, if applicable, dust extraction, protection against high noise levels, vibrations, sharp edges, radiation, etcetera. If you're working on your own account, why settle for less? Never work at, or in, a place you have assessed as unsafe or even hazardous. For example, avoid slippery floors.

In a forest or field (see picture), see your position is comfortable even if you can't prevent branches lying around.

Safety also means that you leave your dog at home, and small children. How small? In our experience, children starting at around 12 years old can be allowed, because they can understand a risk once it's pointed out to them. They can be assigned some jobs they are allowed to do, like stacking bucked branches or passing tools around, like wedges and hammers. Do not let them use an axe or power tools, since these tools are not designed to be used by kids. When your kids are about 16 years old the time comes when they can learn to use all types of tools, including power tools, but, at the start, only when closely supervised.
Of course we all know the stories about a farmer's daughter aged 8 driving dad's tractor. It's up to her dad to decide whether that's safe.

At home or in the workshop, conditions should be as ideal as you can make them. Do set up dust extraction if you're sawing inside. Have good lighting installed. Ensure some fresh air gets in. Some tool manufacturers decline all liability in case of people under age (usually 18) working at their machinery. Don't fall into the trap, thinking that working at home is safer than anywhere else and youngsters run less of a risk.

Most accidents at work (by age group) happen to the category of 18-24 years old; this applies in general: in traffic, with machinery, etc. Even if their reactive ability is far better than the average 50-year-old's is, the older lady or man will usually be more cautious and, often, more experienced and aware of the dangers.
One danger that's sometimes overlooked is adequate temperature control. If you work for a long time at very low or high temperatures, the risks of exposure to cold or sunstroke (both affect your thinking ability) apply. Drinking ample hot, or cool drinks is a good countermeasure.
A spinning circular saw blade causes a rush of air -- if it's cold, that can numb your fingers (because you should never wear protective gloves, operating a circular saw).
In hot weather, sweat can run into your eyes. Loud music or calendars showing beautiful ladies can distract you. Like your dog can do. And if you do the same work for long you can get bored and less alert, or tunnel vision may ensue.

Access and Conduct

When you go harvest material in the fields or forests, **get informed about National, European or Federal Law and the local rules**:

(a) During some periods, areas may be off limits due to hunting season, deer stalking, birds nesting, etc. Make sure you are not intruding in an area where you should not be. Often if an area is closed, that is for security or safety reasons. *This includes your own safety!* Sometimes eg an artillery range will only be used -- or open -- for restricted periods. Make sure when you can go in, and when you can't.
(b) Forest fires, in many areas of Australia, the USA and Canada, and Europe are thought to constitute a major risk and very bad, often deadly accidents happen almost every year. Get informed about the situation. Make very sure that you don't contribute to the risk of forest fire. If you want to smoke, think again about where you're going to do that. Even if, in some forests, you could have an open air lunch or dinner at designated places, having a barbecue is not always such a good idea. If there is a drought, be specially careful, or stay out entirely.
(c) Follow the rules of the Country Code -- respect private property, leave open gates open, close closed gates behind you. And, this is essential, do not block access roads. They may, in case of an emergency, be essential to your own safety and that of others!

(d) Note that, while your vehicle is parked where it does not hamper access, the pile of wood you just harvested may still do just that. Assess the access and make sure you don't create a risky situation, in particular if you leave part of the material 'to be picked up tomorrow'.

Communication

Take care that **other people know you're working, where, and when**, and that you don't want to be disturbed. If your teenagers want to help, tell them ahead what jobs they could do. Tell them what goes and what doesn't. You don't want an argument when you've already started. So likely, ask them the day before.

If you're working in a team, there will probably be team rules about what is allowed and what is not. Follow them or, if you don't see the reason, ask the team boss about them as soon as you hear about them. There will usually be a good reason. *Following team procedures can save lives*, in particular when, for example, several trees standing relatively close together, have to be felled and dragged out quickly; there are cases where you're allowed only so much time at a site. Having a good team is not just nice; it can make all difference between success and failure or even disaster. If you usually work alone, **consider recruiting a friend to help**. This enables you to discuss your assessments (two people usually know better than one). There are some jobs which are more safely carried out by two people than on your own.

In case someone really **needs to get your attention quickly**, have them stand in your field of vision (if you're wearing ear protection like you generally should). And tell them to approach you only when you're not holding a tool or workpiece. A good idea could be to have them ring a bell or flip a light switch that's near the door of your workshop. Possibly it will take you some time to notice that someone wants your attention, but that's better than an accident. And if you think the interruption could have been saved for later on, note that it is their choice to interrupt you, and be forgiving. When someone interrupts you, that someone usually does so for a reason considered important.

Working in your shed, you could be distracted by your wife who asks you what you need from the shop she goes to. Even if well meant this is no good. Arrange for your family to come to you during your breaks (5 minute breaks every hour is not unreasonable) and set a timer (or a blinking light if you have to wear ear protection) to mark your breaks. Keep the working place as neutral as possible. That makes it easier to concentrate on your work.

Appropriate Use

Use tools for work they were designed for. Don't force machines and tools; this is nearly always risky. Don't go in search of hazards! keep in mind that you might lose (a) your warranty and (b) part of your body. When an accident happened because you used machines improperly, your insurance may refuse to cover what you think was insured! There are lots of videos on the internet showing you how tools should be used, and some also show what can go wrong if you use them inappropriately. Watch them and get some good advice!

Long term effects

Wear suitable eye and ear protection, and don't cut corners on dust extraction. Safety, apart from accident prevention, also includes measures that prevent you suffering long term hearing or sight loss, or lung problems. Don't laugh at this -- people have died from lung disorders caused by breathing sawdust.

3 Planning and Preparing

Let's suppose you get a message -- there's a tree you can come and fell, in the garden of Mr X in Richmond, Virginia. You can cut it when you like, but it must be cut and removed before Wednesday the 20th. Or you hear that a tree has blown over and is blocking a road at Warsaw, Indiana. What to do?

(a) Ask yourself whether you're going to take the offer up. If you live in Marion, Indiana, Richmond is a long way off but Warsaw, Indiana is quite near. If the tree in Virginia is something very special, say a IUCN Red List species, but it still has to go -- well, you could contact your buddy who lives in Petersburg, and ask him what he thinks. Or contact IWCS members in the area and ask if they could go take a look. In case you decline because of the distance but the tree, in itself, sounds promising on the phone (or e-mail), ask the owner if you might inform someone who lives nearer. You could do another member a good turn!
(b) Of course an offer can come from friendly feelings but that does not always make it viable. Still you possibly don't want to hurt your friend's feelings. Moreover, if you DO take it up and honour his feelings, chances for follow-ups may remain.
(c) You might get a very good mark if you can get the tree blocking the road at Warsaw out of the way quickly. In some cases you may even get some payment for clearing a road. However, note that blown over trees sometimes will show very long cracks, diminishing their value for use a lot. And they may be under tension.
(d) Then there's the size of the tree, which might be more than you asked for when you arrive there. Keep asking the guy who informed you and try to get a good picture in your mind of what you're going to deal with. It's frustrating, after you drove many miles, to have to admit that 'after all, it's beyond my capacity'.
(e) Ask around with your buddies about sharing the job, and the wood. If it's something really special we bet it's not just you who has an interest. Sharing the job also means working in a team, which usually is safer than working alone. It's also more fun sharing the elbow grease as well as the benefits.
(f) How accessible is the tree? Well, if it's blocking a road it should be near a road. But it might be in an inaccessible place where a car cannot go. Ask about it! A wheelbarrow can sometimes wonderfully solve your problem; and, if the distance is not too bad, muscle power (animal or human) and some ropes can be used.
(g) If it's in someones back yard, how does it reach the street without damaging property? And how about felling it without damaging property?
(h) And, to finish, look at road and field conditions. If the ground is frozen that's wonderful for dragging sections of bole over. However, there may be ice on the roads which is less wonderful. Think ahead to prevent your car, and trailer, to do tricks you never thought they could do.

By now you have noted that *some practical knowledge about trees is useful.* Where does safety come in? Well, some trees have **toxic wood.** In case of blown over trees, some branches may be under **high tension** that may be a hazard when you're sawing them up. You should have an idea about the **size** in order to arrange safe transport, and in some cases it will be necessary to have a freight truck at your disposal. **Don't overload your car.** Yes, there is a safety margin but keep within recommended limits (if you

exceed them, you might transgress the terms of your insurance).

A sturdy trailer will do a good job, in particular when the distances are limited. Driving a couple hundred miles with a heavy trailer is no sinecure. So why not ask a buddy who lives in the area? He may be able to store the tree you've felled together at his farm, then saw it up, and let you have part of it. And don't hesitate to contact your fellow members. Many of them know all about the qualities and hazards of trees; they can usually tell you whether it's worth while. And -- you might have your own tree to bring to the next Annual Meeting!

Now let's say that after you hear from the man in Richmond, Virginia you called your buddy in Petersburg. He has taken a look and found out what species of tree it is. He invites you to drive over and do the job together; and it will be nice to meet up. The tree is only 34 miles away from his home so the distance is not a problem. It proved to be a yellowwood tree (*Cladrastis lutea*). It's not that rare, but its wood is beautiful and could make very special furniture. It's of such a size, 2'6"~75 cm diameter, and length, 16' to the first sizable branch, that you think makes it both worth while and doable, even if you' ll have to get your load to his home in two runs. Now you have to ask yourself some questions:

(a) Will your driver's licence permit you to pull the size of trailer you need? this is not a matter of course, since driver's licences can vary a lot by state, or even county. Have you done this before? Is the trailer up to such a load? How about distributing the load between the car and the trailer?
(b) Are you well fuelled up? It may be less than easy to go into the gas station with a trailerful of wood. How about the tyre pressure? If you carry a heavy load, you might inflate the tyres a little more. Did you check the brakes?
(c) Have you checked your chainsaw (excellently maintained, of course)? Have you thought about putting a spare chain or two, oil, gas for the saw, files to sharpen it, etc. in your car?
(d) Does the weather permit your driving with a heavily loaded trailer? Do road conditions permit it (if a load of snow is predicted, think again).
(e) In case you have recruited help, is there room in the car? Do they go in their own car? Are you going to pay them (eg for their petrol), and how much? Or would they like to get some of the wood? Are you paying for lunch or dinner for all? How about some hot coffee or soup in a Thermos bottle? In cold weather this improves your well-being and, therefore, safety!
(f) Take cleaning gear with you, and some felt pens to mark the pieces. If applicable take a net or ropes or chains to secure the load on the trailer.
(g) How about time planning? No hurry, no worry. In case you need special gear to get the tree to an access road, plan for the extra time and make sure you bring the gear. You might want to recruit some local help, or ask the owner to do so. Of course, count on paying for lunch or coffee for these people, apart from your own gang.
(h) Bringing a friend is fun, and usually good for safety. In case you're really 'out in the woods', be sure to pack a substantial lunch, and take your time eating it.
(i) In winter especially, have you considered the time it gets dark?

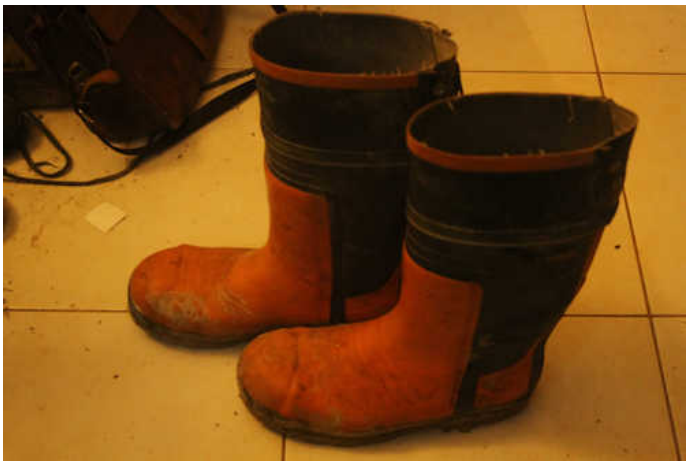
In many cases, it's you who is going to fell the tree. See the next paragraph.

4 Safe Tree Felling

Leave felling trees to people with ample experience. Don't fell a tree you're not confident about. Admitting to insufficient confidence and declining a job is a better show of wisdom than being sorry afterwards. However, if you informed yourself well, you should know whether you're up to the job, or not. Once you see the tree you will know where it should fall. Sometimes, owners don't have a good idea about felling a tree. In gardens, it may sometimes be impossible to fell a tree at one go without causing damage. In such cases, there may be nothing for it except sawing off the branches one by one, secured by ropes, and repeating this on the bole. Although it's not generally recommended to attach pulling ropes on a major tree that is felled, this may be the only option. This is certainly work for the very experienced and not for those who still need to get an education in felling. You can see why in many videos on the Internet about accidents happening.

Using the chainsaw

Of course you can take someone along who owns a chainsaw and has the necessary experience. Using a chainsaw seems so easy and it often it *is* easy. However, a chainsaw is potentially a dangerous tool and if an accident happens it is often serious. The main thing to learn (by doing, under supervision) is to see which way a tree wil 'naturally fall'. To an extent, you can determine how it will fall, and in case of upright trees it's often possible to lay down the tree *exactly* where you want. In case of badly leaning trees this is not possible. Either you refuse the job, or, when it's allowed to come down the way it's already leaning, it's a very easy job -- in principle, because a leaning tree may be under tension.



[*Fig. 2. Sawing boots by Stihl*]

There are minor hazards that you will, over time, almost automatically encounter. If you know, can see, or suspect that a tree is under tension, this can be remedied to a large extent by making a series of shallow cuts on the side it's leaning toward. If you're dealing with a really large tree, say over 50' high and/ or well over 2' diameter, that you have reason to believe is under pressure, call in a professional. Know your limits -- if you don't feel confident, don't do it!

Apart from that, there are some general guidelines.

(a) In case your chainsaw binds (usually this happens in bucking, not in felling), you can pull it out partially, spray with WD-40, then try again. If it binds in a cut already very deep (usually you can see the cut getting narrower on the top) you forgot to support the section you're cutting. Or that was impossible so you shouldn't have tried without hammering in wedges at the top, as soon as the depth of your cut allows. Of course you can stop the engine and try to jack up the tree a little, to release it. Or still start hammering in wedges, starting just above your saw, working to the top. Or a combination of all these measures. We always take lots of wedges and even for use at home have about 10 wedges ready for use.

(b) In case you suddenly see fireworks, you've hit metal (usually you have not struck gold) or a pebble encased in the tree. Stop the engine as soon as possible and draw out the blade. If you're lucky, you'll have to entirely re-grind your chain. If you're not, put a new chain on and don't try to finish your cut (even if from the other end -- the pebble will still be there). It's a good idea to always carry some spare chains.

(c) Working with a chainsaw is never 'safe' because chainsaws have high RPM and when they cut into someone the consequences are always serious. This does not happen to amateurs only! But you can protect yourself. Sawing boots and sawing suits are heavily packed with fibrous material that stops your saw *very* quickly. We've seen live demonstrations where a guy *tried* to saw into his leg, the saw gripped the fibres, stopped within 1/10th of a second and the guy pulled up his trousers to show... nothing. He admitted, though, that the next day his leg would likely show a black mark, from bruising – but that he could still 'show a leg'.

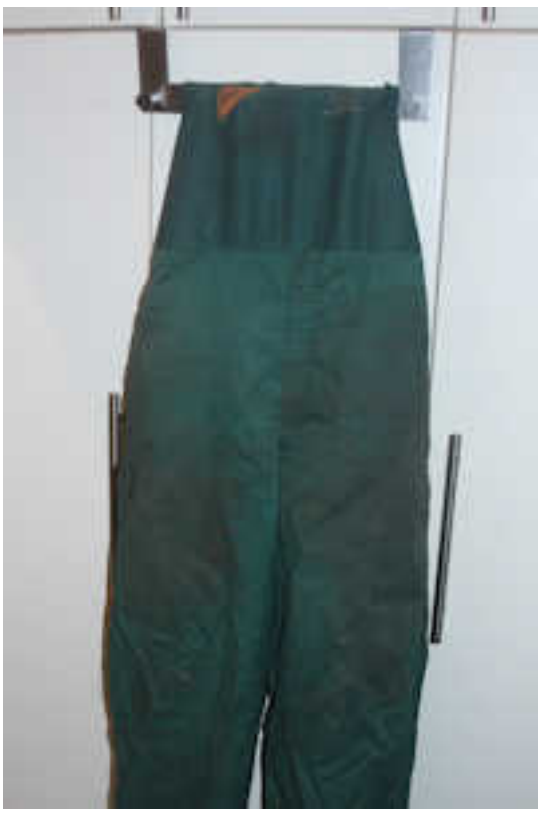


Fig. 3. Safety suit. Frequent washing not only promotes smart looks, but effectivity as well!]

(d) In many cases, dealers will ensure buyers of chain saws an enrollment for a course in safe use of the machine they bought. A good idea when you doubt your experience. You'll learn safe working routines, the points to check, and maintenance of the saw which also contributes to safety. A saw that's sharp and handles well contributes a lot to safety. It's less prone to binding and kickback. Working with a dull saw is unpleasant and moreover invites these risks. It can even cause a broken chain.

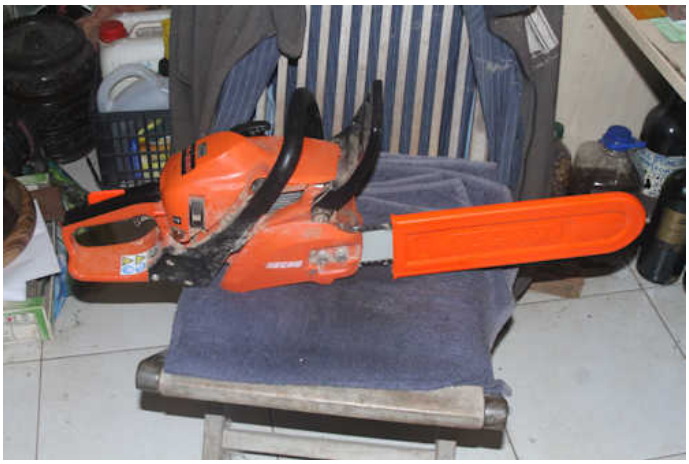
(e) Even if we're not accountable for what you do with a chainsaw, we again ask you to learn on the job, supervised by someone who has ample experience. Every accident is one too many, and chainsaw accidents are rarely minor.

(f) In case it proves that the job is too much for you (we have the experience) you could ask someone to fell the tree for you, for a reasonable reward. When I was about 30,

using my first chainsaw, I once made the deal that I would saw up all the small wood for fuel to be used by the guy who felled and bucked it for me. I knew Cees Landman had the experience and was happy to teach me some things. A good deal for both of us since it was a 2'8" diameter horse chestnut that eventually yielded over 75 12" to 14" bowls. A good deal for him since the branches made 2 cubic metres solid of fuel. It cost me a lot of work but, helped by Cees I learned a lot, of which the main thing is:

Whoever is sawing with a chainsaw must never be called or distracted, whatever happens. This is an important cause of accidents so please never do this. A 'classical mistake' is when two people are both felling a tree, too close together, at the same time. Never allow this. Ensure a very ample distance if two people, or teams, are felling trees. Ensure that the trees are felled one by one, never together.

Dust is generally no hazard when using a chainsaw. It's produced only when your chain teeth are absolutely dull. Given a reasonably well sharpened chain the chips should be crude. What a chainsaw really does, is shaving the wood out, so a slot is formed in it. It's easy to feel when your saw gets dull. Even in very hard wood, progress with sharp teeth is good, although the teeth will get dull sooner. In the best cases the chips produced should look like these of a router-joiner.



[Fig. 4. *Storing the chainsaw: with the cover on. Preferably indoors.*]

As a principle you should sharpen the saw everytime you fill up with gas (or mixed fuel for two stroke engines). After some experience, sharpening the chain takes only 2 to 3 minutes. The chain stays on the saw, you just let it cool down a little, then sharpen it on the top, releasing the brake and moving the chain 2 times so all teeth can be sharpened.

Using the bow saw and pruning saw

Of course a bow saw can often be used -- I've used it for the first time to help release a badly bound chainsaw (not mine, my uncle's). Really a garden tool, it will saw through about 6" of wood with little effort with the right tension on. Almost all shrubs up to about 20' high can very well be cut with a bow saw. This is also very useful to saw off branches of large trees. However, beware when they are under tension, eg with the weight of the tree pressing on them.
For larger trees the bow saw is not recommended because the friction will cause a hot blade and much quicker wear. Moreover, a bow saw tends to bind in deeper cuts.

Keep in mind that lesser boles (say, anything over 2-3" diameter) have to be cut in the same way as 'real' boles, using a felling wedge cut, then a cut from the oppisite side, a little higher. This is because small treelets and shrubs can split as badly as larger ones.

Even if the bow saw does not have a reputation of causing very serious accidents, its teeth are still very sharp and can cut someone rather bad. In Scandinavia, the bow saw is often used to fell and buck birch trees, that often don't grow to a large diameter. We've used it a lot to cut branches off coppiced willows. It makes for a special, nearly silent working atmosphere that we found very attractive.

Pruning saws, often sold at garden centers, are slightly curving saws that saw on the pull stroke. To make our life easier, they can sometimes be attachhed to really long poles, so you can saw through branches far above you. If you're using these pole extensions, remember to work very gradually and keep in mind that you have to saw from both sides. When the saw binds 15' above your head, you're in trouble. Also consider where the branch is most likely to come down. All recommendations given for the bow saw apply; however using a pruning saw on wood above 4" diameter needs experience. The largest and hardest wood we cut with it was Yaite /*Gymnanthes lucida*, at Puerto Morelos, Mexico where a specimen had been blown over by tropical cyclone Wilma in 2005. Diameter 7".
The problem with pruning saws is that they tend to go dull relatively quickly.

If your pole is too short (or the branch is too high), forget about it. We don't recommend the use of ladders in combination with sawing. Such jobs are suited for professionals who don't need this manual.

Trees in a Bad State

You sometimes come in for a nasty surprise. The owner sometimes doesn't know or care much about trees and he failed to notice that his tree is rotten almost right through. Or that it shows such spiral growth as to make it suitable only for fuel. Or that it's full of barbed wire, or shows major cracks. In all these cases, ask yourself how much it's worth to you to maintain friendly relations with this person. In case you were going to pay, you can usually say the material isn't really worth the money (and you can probably show it). This, however, applies only in case you thought about asking questions re the condition of the tree. If the owner said 'well, it's an old tree but it looks sound' you are not to blame. Because sometimes it's hard to see that a tree is in a bad condition. Please note that some trees, even if rotten almost completely, may still show vigorous growth.

However, if you did not ask about the condition the tree is in, you 'll have to eat humble pie, make the best of the situation and bow out. Very likely this will happen to you only once. Anyway, this isn't going to make anybody very happy. Possibly, you can save the day by felling the tree that was said to be sound but is not, being paid an appropriate reward instead of getting the wood.

5 Bucking and Pruning

The dangers of bucking and pruning are lesser, compared to those in felling. However, they exist, in particular when you're dealing with a heavy bole. When you finish a bucking cut, your workpiece may roll away; binding is a typical risk

here; as is kickback. Or tripping over cutoffs on the ground...

We suggest you start to drag out all branches that can be removed. Make sure some room is clear behind you, enabling you to step back with confidence when necessary. If branches are pinned down by heavy stuff and are in your way, get out the **bow saw** or **pruning saw**. Always reserve the very heavy branches for last: (a) they can usually support a lot of weight and enable reaching parts of the bole that (after cutting the branch) will rest on the ground, and (b) the more lighter material you cut off, the more you will reduce tension on these last heavy branches. In this case, follow your natural, lazy inclination and start working on what looks easiest! Don't forget to drag all this material to somewhere outside of your working area. We recommend use of a bow saw or pruning saw to cut off this material -- unless you're very experienced at pruning with a chainsaw. Because it's 'so easy' and it's quite a repetitive job, routine blindness can ensue, with bad results or grave consequences. In this -- well, in al cases -- we recommend that you take regular breaks.

Some of these branches may be under tension, so take care. And if some obnoxious, not-too-thick branches have got pinned under the bole and are in your way, instead of being sawn through, they could be chopped off using an axe. This also applies in general, and it may be easier to chop off really minor branches, say up to 2". There are sickle-shaped cutting tools, designed specially for this purpose. They should be very sharp, it's easy to learn how to use them, but you should always have the tree in between yourself and the tool. Otherwise, their razor sharpness makes them very dangerous to use. Somewhat safer is a version of the same, mounted on a stout 2' - 3' handle. It works by pulling hard and if sharp enough, will do a very good job. Preferably use these cutting tools 'from bottom to top', as the tree is oriented.

Ensure you carry lots of wedges. You can't have too many wedges, we recommend you routinely take at least 20 with you. They are used for keeping cuts open to prevent binding; to forestall parts of the stem rolling away; and in somewhat larger trees, in felling, to put some tension on the final cut. With the exception of splitting a section through the heart, we always use wooden wedges – when cut into, that ruins one wedge, not your expensive chain or worse. We recommend large wedges made by sawing a 16" to 20" ~ 40-50 cm section of 3"x3"~8x8 cm diagonally. A few even larger, and smaller wedges will come in handy as well. The wedges will taper well enough to be hammered under a bole and will bind beautifully in your cuts, keeping them open and preventing the saw from binding.

If you're bucking, either start by sawing off 'pieces hanging in the air' or make your cut exactly where the bole is supported (e.g. by wedges you hammered in from both sides or where it rests on a really solid branch that lies on the ground). When the ground is too boggy, that won't help much but then again, large trees rarely grow in boggy ground, Cypress (*Taxodium distichum*) being a notable exception. When you saw off an 'end piece' always be prepared for it to fall before you expected. If you first make a shallow cut from below you are more in control and can make it drop right down at about the expected moment. Beware of it rolling your way; you could put something on the gound, eg a big wedge, to prevent that.

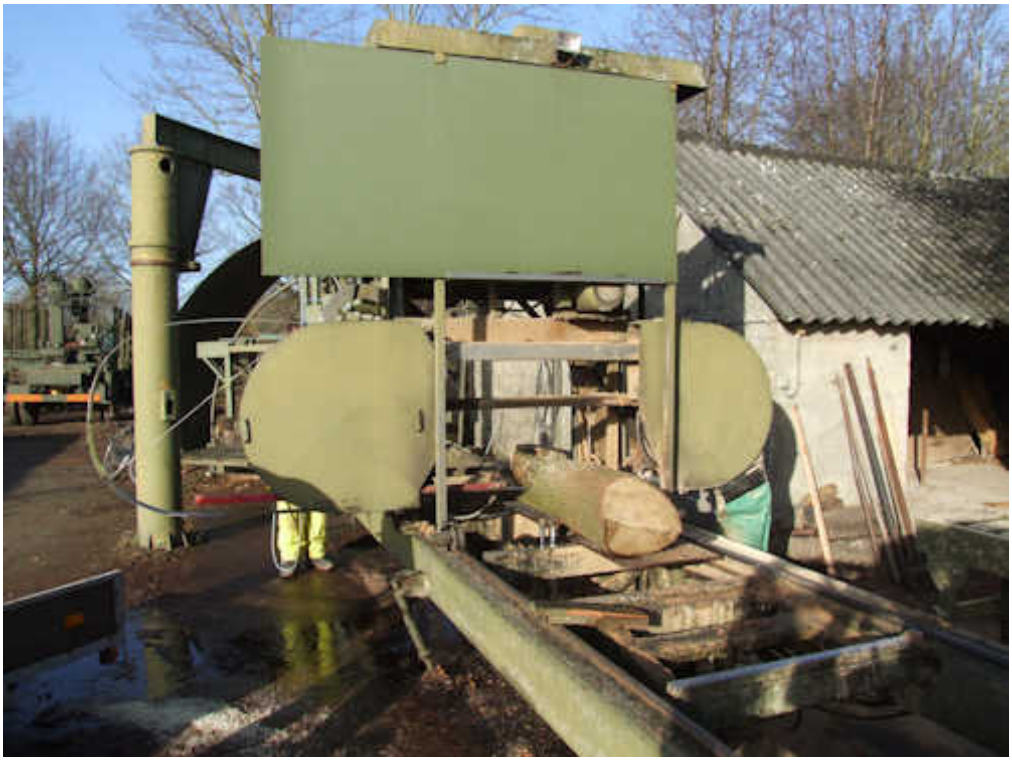
When sawing branches under tension, keep the bole between you and the branch. Before you get down to bucking proper, it's sometimes better to saw the bole into 2 to 3 sections; that depends on the branches it's supported by. This is one of the things you have to learn by training on the job -- but it's fun, and moreover, supports safety.

How long to cut your sections? It's not just a matter of weight, it also depends on what you're going to use the wood for. If it's valuable and you're going to make major furniture, you could cut 4' to 5' or even 6' sections -- which will be immensely heavy. But if you know the end goal is large furniture, you will, without a doubt, have planned for transport. Remember it's not just about what your trailer can carry, it's also nice if you're able to lift your bole sections on to the trailer...
If you're going to use the wood for turning, just cut about 1" of oversize length at both sides. If your going to turn on the faceplate, it makes no sense to cut sections much longer than the tree diameter -- but here, an extra inch on both sides is helpful.

Since green wood can, usually, be split more easily than dry wood, taking a froe along and splitting through the heart can be a good idea. It will make your pieces of green (and therefore heavy) wood easier to lift and handle.

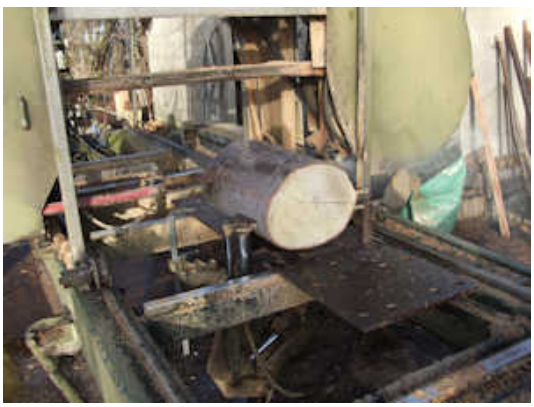
6 Using a Wood-mizer or Board Saw

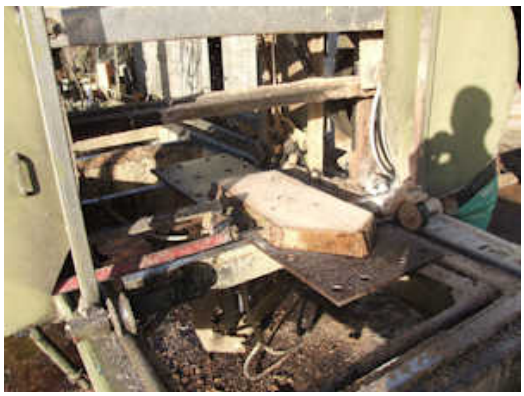
If you happen to know a Wood-Mizer owner (or own one yourself) you can saw whole boles into boards the length you have decided on (maybe the entire length you cut). Since boles tend to be heavy, be sure to use machinery or other aids of sufficient capacity. Using a Wood-Mizer is great, but you don't want to test it to its limits. Of course a local sawmill could help, if they can saw at what you consider a decent price. Generally they don't like sawing very short (and lighter) sections, so you really should give this ample thought.
When you're lucky enough to live close to an inventor, that helps -- the late Erik Both, former chairman of Nehosoc, a mechanical engineer by profession, designed a special tool for sawing short sections safely. It's still in use in combination with a bandsaw at Wim Geurts' sawmill in the Netherlands, enabling safe sawing of short sections.
In case you have your bole sawn into boards at a sawmill, that will take some money and, possibly, patience. Of course, cost can be somewhat reduced if you're there to help marking pieces, checking size, etc. Usually a professional sawmill gives you slightly more wood from a tree than the Wood-Mizer does. It all depends on what you want. Note that when someone else does the job, someone else carries the risk. Whether you cut it with a Wood-Mizer or at a sawmill, you'll get boards that will be easy to store and dry just because they are straight.



[*Fig. 5. Sawmill at Wim Geurts in Neerlangel, Netherlands.*]

It's cheaper and easier to saw from the top (or one side) and continue sawing boards until there's nothing left. There are those who, in many cases rightly, decide that they want as much quarter sawn wood as possible. Or as much flat sawn wood as possible. That's more expensive; suffice it here to say that quarter sawn wood is usually more stable and has less movement in service. It's logical if you think about it, but this means a stack of quarter sawn wood is also more stable -- hence safer -- than a stack of flat sawn wood. Note that you have to consider material damage, eg caused by a stack falling over, as well.





[*Figs. 6,7. Sawing a short section using Erik Both's special aid. First, a cut through the heart is made, then boards are produced.*]

7 Doing your Math

We generally recommend stripping the bark off the wood, prior to drying it (for naturally or kiln dried, equally applicable). The bark often contains eggs and larvae of insects that will eat into the (still living) bark and the sapwood. Moreover if you stripped of the bark you know what real size you have. It can be

feasible to cut, peel or tear off the bark right in the forest. That will also **reduce the weight during transport**. In trees with a substantial bark, which will usually be heavy with sap, this can make a difference! Note that several, very sharp utensils are used to shave off bark. They work very effectively but (we're saying it again) you have to learn how to use them. Also, the quality (or lack of it) of the wood may reduce the weight you're loading, even if that's not what you wanted. On no account take wood you're going to throw away yourself [but you could help the owner get rid of it].

An example – Best Practice

If you cut a piece of wood for samples, how many will be there? if you've done it several times before, its relatively easy to make an estimate that often proves accurate. A cilinder contains π (circa 3,14) x radius squared x length of the cilinder. Let the length be 16" = 1 foot 4 inches, diameter = 2 feet. So radius is 1 foot; hence we get a volume of 3,14 x 4/3 cubic feet, equals 4.18 cubic feet ~ 115 litres.

Of course you'll lose some due to wane and bark. If you consider the volume strictly, there should be 220 samples in a cubic foot. In case your piece has an excess length you're not going to use the rest. Think in increments of the sample length, usually 6". 1 or 2" in excess is fine, but more than that will be waste material. In theory 1 cubic foot would make 220 samples, but that's discounting the width of the cuts, some cupping and warping, etc. So it's more realistic to count on about 120 samples per cu. ft. Leading to a total of some 480 samples. Of which you'll be prone to assign some to the stove. You also lose the excess length you're not going to glue together. So if you get around 340 samples in all from the section mentioned above, that's about it.

So often it's wise to prevent frustration by getting some excess wood, more than your calculations indicate. So you can chuck the wood around that rotten knot. Or the samples that had a drying crack in it. In particular, get a little excess length -- 10% is fine.
Will our 4.18 cubic feet piece be easy to handle? Suppose it would be oak. Fresh oak would weigh about 1050 kilos per cubic metre, so our piece of 4.18 cubic feet ~ 115 litres will weigh 120 kilos or 250 pounds. It's not easy to handle, so you're almost bound to either split or saw it into 2 pieces. At 125 pounds they will still not be lightweight. To apply safety to lifting and handling, consider how feasible it is to split, or saw, the bole sections through the heart, halving their weight. It's better to pull this trick than to pull your back muscles!

To know the total weight you're loading is not 'just convenient'. It's essential if you're toting up and check with what your trailer can take. Which, in turn, is based on what the manufacturer thinks is safe to carry. Also consider your car pulling a very heavy trailer. What happens if you run into a wild animal crossing the road? Or have to go up an incline? If you're slipping on an icy surface? Probably not something nice. Think ahead and come prepared.

Mark all your pieces with their botanical name, if you know it, and with the details you can get. Use indelible chalk or a felt pen. Don't use numbers, they can be duplicated before you know. Avoid confusion...

Another example -- don't waste, but keep safety in mind

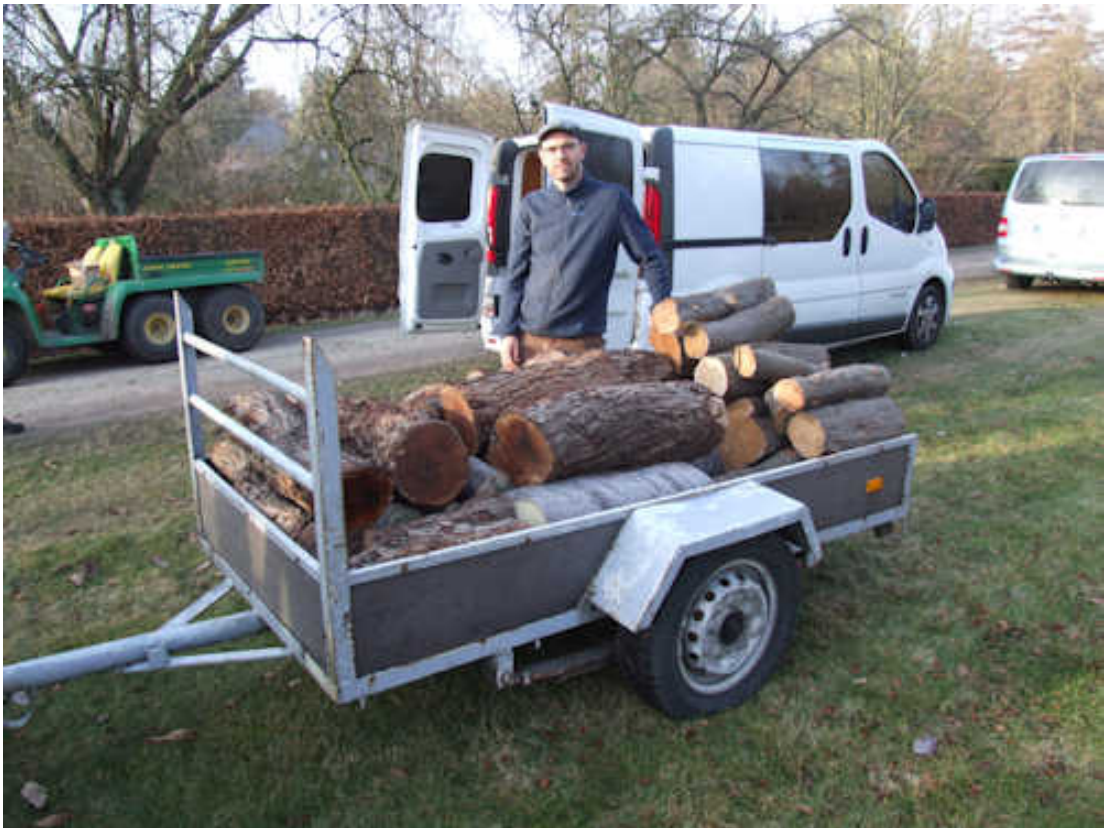
After you cut the pieces off the tree that you're going to use for projects, the

branches are still lying about. Usually you have to remove the branches as well. Why not cut them up for fuel? Even if the kind of tree you cut may not be a well known fuel species, remember that all woods, in principle, can be fuel. The only real exceptions being toxic woods like Manchineel and Poison Ivy, because even their smoke is poisonous. Woods that are safe to handle when dry are usually safe to burn and you are not likely to want to use toxic woods for any purpose. If you're unsure, search on the internet or look it up in a wonderful book that may hugely contribute to your safety:
Mind-altering and Poisonous plants of the World (2008) by E. Wink & B.E. Van Wyk, published by Timber Press.
When cutting up for fuel think about who will use it. If that's a reasonably able person you can cut into trailer lengths and load up, secure it by some straps or ropes, and off you go. If it's a really old old timer, you might want to take the trouble to cut it into sections fitting in the stove. But in that case you'll need a trailer with sufficiently high sides. Or you could put the rear seats of your car down and put it inside you car.

8 Loading up for Transport

You have been careful (and a bit lucky) and everything went according to plan, the tree has been felled and bucked, the branches cut off and a friend has come with his trailer and is loading up the fuelwood -- not too heavy and easy to handle.
Of course, when you rang him you asked if he could give you some help loading up the biggies. When loading up your trailer, make the balance so that the load in front of, and behind the wheels is slightly off, leaning forward. But only slightly, you should be able, using one hand, to lift the bar unto the pulling ball of your car.

If your car is suitable to ride wood roads, it's usually suitable to load a lot of wood in -- **check the car's manual and know what maximum weight is recommended**.
If possible given the size of pieces, try to load equally over all of the loading surface. Or, again, consider putting the heaviest pieces in the car, not on the trailer. And don't rule out that, after getting informed, you can decide to leave the trailer at home, then load all the wood in the car. If you have a farmer's car with a large open compartment that's ideal. Don't try it in your brand new Ferrari. If in your car, put the main weight in front of the rear wheels.
Then it's almost time to go home. You have taken your break and checked, of course, what will happen if you need to make an emergency stop. Are you sure the large pieces won't go rolling around? Will the small pieces not fly forward? There have been cases where drivers were hit by material that was in their car, high up, and became missiles. Don't let it happen to you. Put something sturdy over your load, whether on the trailer or in the car. And when driving, adjust the speed to your load.
If you're using a trailer, it may be a good idea to put some 'worthless branches' on the top to enable your load to be strapped down more securely.



[*Fig. 8. Reasonably well loaded trailer used by Cedric Pollet. Some of the little pieces in the rear should come forward and all should be covered by a sturdy net, tied down well [the net being a local requirement in the Netherlands].*

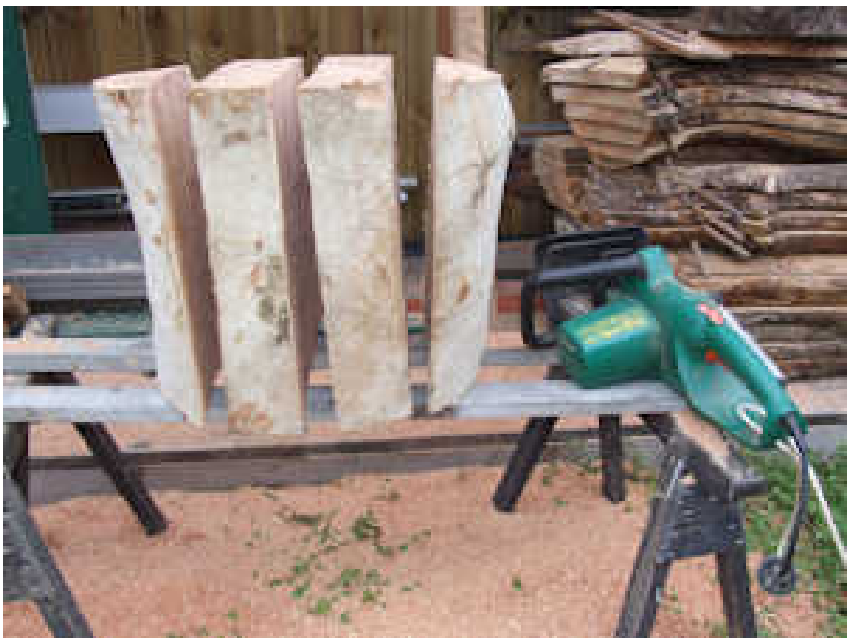
Don't load up so far you're wondering how much more the trailer can take. If it starts to wobble, it can dictate the movement of your car and cause it to go out of control. If you have only a few, but very heavy pieces, using a trailer may not be the best idea. If they really don't fit in your car, secure them separately, absolutely preventing their going on a roll in a tight curve or when you have to brake.

In case you have two pieces like in the above exanple, 60 cm~2' diameter and 1'4" length, try hard to get them in the car, eg on the rear seats over which you put an old blanket. If you can't, tie them down with so much rope you didn't know existed. And pull hard on the knots. Here, again, the wedges you carry may come in handy. You can use them to put some extra tension on the ropes. Pay attention to the rules applicable to trailers. You don't want to waste your possible profits paying a fine to the police [who, remember it, are out there to ensure general safety!]

In case you have not two large pieces, but pieces by the score, consider (a) which pieces you will take, which you will leave. (b) Where you're going to leave the 'left pieces'. Make sure they don't hamper access. Even if you decided to come back to pick them up. Or (c) call a friend, saying they are his for the taking. Again, your friend who came for the fuel wood may save the situation: he could possibly load up some more, or put pieces in his car.

If, for any reason, you loaded more than you expected, think about pulling into the nearest petrol station and inflating your tyres a little more. If under high loads, and if you must go a long way, a higher tyre pressure is usually recommended. This may not be easy -- but better safe than sorry. Of course, when you see how much there really is, a quick trip to the nearest petrol station to inflate the tyres some more *before loading* is even better.

Now you see why it's important to know the situation on the spot. In some cases they will ask you to 'get rid of it all' and urge you to take as much as you possibly can. Depending on what wood it is, you could alert friends who can use the material, if they don't live too far off. Or they could have come in their own cars to see what they can get. If you did your preparation well, you will know ahead of time and are able to handle the situation with ease.



[*Fig. 9. Sawing short Eucalyptus viminalis bole sections using an electric chainsaw into boards about 4" thick . Electric chainsaws are a good choice for use at home, since they are much less noisy and can be used indoors. Regrettably they aren't much safer than other chainsaws.]*

Driving home

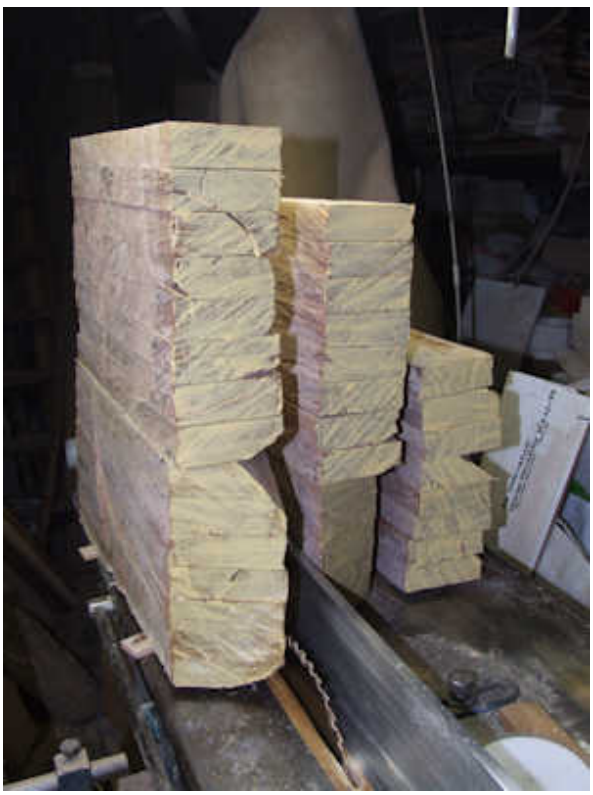
You' ll naturally not drive as fast as you usually do, the car being unable to do so when pulling a substantial trailer. That you should adjust your speed seems a matter of course and we're only noting it here because, despite all the warnings, accidents are happening due to loads being wrongly distributed, insufficiently secured or just too heavy. Or because 'the sun was almost setting and I wanted to get home before dark'.

The service manual of your car should state the maximum load. If you don't have it handy, follow this rule:
If yours is a 'small family car' and you loaded up 300 kilos~700 lbs; or a stationwagon or 4x4 and you loaded up to 900 lbs~400 kilos -- you can 'drive as usual' assuming the wood is in the car itself. Count your own weight in. For every 220 lbs~100 kilos more, reduce your speed by 10 km/h~6 mph. You should really do this.

The weight included in your car increases its kinetic energy and will make your braking track longer, because there's more energy to be dissipated. The kinetic energy is 1/2 x mass of your car x velocity squared. If your car weighs 2,000 lbs and including load it is 3,000, it means 50% more weight. Regardless of weight, if you drive at 75 mph instead of 50, the difference in energy is not 50% but about 125%! Combine this thought with that of a heavy load... Reducing your speed makes very good sense.

9 Re-sawing to boards and storing

This means getting your wood stored effectively. If you did not do so already, cut the sections of bole through the heart. In case of moderate diameters you'll use a chainsaw or a circular saw; if larger, a chainsaw or bandsaw. Remember there are special chains for board sawing. Using a chain saw requires that you stop the parts from moving when sawn through -- use wedges. Whatever saw you use, remember that from diameters starting around 18", and 2 ' for sure, it's often good to saw the bole into quarters -- bar when you're making a park bench or table top, of course.
We just mentioned circular saws and bandsaws. Like a chainsaw they have sharp parts that move fast. However, with a bandsaw and circular saw you can do much more to reduce the risk -- *no risk* being, regrettably, impossible -- but we already know.



[*Fig. 10. These sections, about 4" thick have been sawn into small boards about 1 1/4" thick and the ends have been sealed.]*

Whatever type of saw you use, a very sharp saw is always the best. It will put less strain on the motor and will make a clean straight cut. A sharp band means the saw will not easily deviate from the true, sharp teeth on the circular saw makes cutting unbelievably easy. Generally, sharp tools and a clean, well lit working area contribute more to safety than most people would believe.

Preparing for sawing: Motor plane or Planer-Jointer

To enable safe sawing on a circular saw or bandsaw, your workpiece (as we're calling it from now on) needs to have a flat side. That's the side on which it can rest when it is pushed through the saw, using a guide rail. You could use a motor plane, a handheld device that really works like a planer-jointer. Or you could think of using a large, stationary planer-jointer. The handheld version is potentially dangerous but unless you really try hard, it's difficult to have an accident (you normally have both hands on the safe side of the device). You could also use a wood shaving spoke or hand

plane, but that's really for those who love slow progress.
If you're going to use the handheld motor planer, remove very little material at a time, this makes for light passes and more control. The face you have planed need not be mathematically correct -- if it enables you to make a gentle smooth pass along the guide rail, that's fine. In case you want to use the stationary planer-jointer, turn a few pages down and read about its safety aspects before you start working!

Bandsaw

When you push your workpiece 'through' the bandsaw, you should move slowly but steadily. Generally you will know how much tension to put on the band -- see the manual -- and whether the band needs to be lubricated, or not. There are those bandsaws you must lubricate, the Wood-Mizer being an example. Their bands are moistrened using a mix of oil and water. However, since lubrication can promote slipping, please check. All band saws designed for metals (which can sometimes be used on very hard woods as well) have to be lubricated.
Many bandsaws must never be lubricated in this way, for the band wil slip on the wheels. If the sawing band is lubricated, friction inside the wood is reduced, but this also applies to the driving and trailing wheel that can cause a slip-off which can be dangerous.
Check if the width of the band is suitable for sawing through the depth of wood you want to saw through. This depth is related to the width, hence strength, of the band and the tension it can take.
Remember to put the correct tension on the band. Only then will your bandsaw make a straight cut. If tension is too low, the cut will deviate; if tension is too high, a lot of strain is put on the band, and in both cases it could snap. Let the protector guide sink as low as possible above the workpiece, which means that it can only just pass through the gap. Allow only a few millimetres~ 1/8" of clearance.

If you really have large boles to saw, or have a lot of lighter material, it may be as well to ask someone to do it for you at a proper sawmill. Some will refuse rounds, others will happily saw them. Note that almost all sawmills make you pay for a new band if they strike metal inside 'your' wood.

The distance between your hands and the band is easy to get, using a couple of pushing aids on the sides of your workpiece. You can use little boards with a corner cut out a little askew, similar to what is often used with a circular saw. Just push through slowly but steadily. They can also be bought, in which case they will be of some synthetic material. We like wooden ones better, because if you saw into your plastic aid, the material burns and gives off noxious fumes.
When using a bandsaw, wear tight fitting clothes, preferably an overall suit. No gloves, no shawl, no tie, nothing that could be seized by the band.
A bandsaw is very practical for making wedges. Just use some wood that's discarded, but otherwise sound.
If you need to make cuts out of the true, a customized jig you can make will be a great help with a bandsaw, or circular saw, e.g. if you're making coopered columns where you need a 22.5 degree angle. It's better to correct your jig from time to time than having to discard the possibly expensive wood meant for a project!

If you saw *narrow pieces* on a bandsaw, in particular when they are high, they have to be preferably clamped or temporarily glued to some 'side pieces' for support. In case a

narrow hard workpiece tends to bind because it's supported insufficiently, you're not going to like the results. Never saw narrow, high pieces without properly supporting them, you're taking a big risk when you do.

Circular Saw

The dangers of circular and bandsaws are quite similar. Use pushing aids, don't wear any loose garments, don't wear gloves. And if practicable, make one of the sides of the workpiece a flat face. Not mandatory, sometimes not practicable, but undoubtedly safer. In case you have to saw narrow pieces lengthwise, make sure you use aids that keep your hands way outside the blade area. In sawing narrow pieces, chances of kickback are higher.

With a circular saw, dust extraction is important, more important than eg with a chainsaw or bandsaw that both make chips. Here, it's real dust. If you ever saw a dust extractor you know how much dust you can make. You really don't want to breathe it because it can, both mechanically and chemically, affect your lungs. Since the saw gets hot, sawdust usually contains partly burnt matter (like soot) which is very noxious.

Since stability usually means safety, working at a very heavy circular saw setup, or a combination machine weiging a ton, is a lot safer than working at a lightweight saw. Just think what would happen if your lightweight saw falls over when it's running...

[Fig. 11. Circular saw on a Robland combination machine that weighs 400 kilos ~900 lbs): stable and as safe as a circular saw can be. On the right is the riving knife that will keep open the cut you just sawed. Able to saw cuts 80mm ~3 1/4" high.]

A good circular saw has a riving knife that keeps the cut open. Why? When you're sawing green wood, tension can cause the cut to pinch, or do nothing, or split wide open. Before you make the cut it's very hard to say what will happen. If the cut splits or stays the same, nor problem. But if it pinches, it could cause severe kickback.

There is no real remedy, since the problem is not caused by unsafe procedures, but by the workpiece. There is a partial remedy -- the good old wedges, in this case small ones. If you're sawing 3-4" boles (well...) lengthwise, use of wedges may not be very practicable. However, having experienced a serious kickback we're sure you *will* try this method. And again, if you get the feeling that the wood you're working with is just tricky, you could still consider splitting...

Splitting instead of sawing

There's an option, sometimes considered primitive, that should not be discounted: splitting. In cases where sawing makes you feel uneasy, consider splitting. You might lose some material, but that's better than losing an arm. Green wood is usually easier to split than dry wood; And if you go to the link below and watch the video, you're probably never again going to say that splitting is primitive. If you know how to use a froe, or any splitting device (even a fuelwood splitter could be used on larger pieces), **splitting can be extremely effective**. Splitting with an axe can sometimes work surprisingly well, provided you have the right type of axe. Straight grained material can often be split with ease, even if the diameters are large. The Americans who settled the West after the Homestead Act of 1862 used a lot of clapboards, split off really

long tree sections, to build their homes in wooded areas. In particular when you're splitting, practice makes perfect.
If you don't have a froe or hydraulic splitter you should try using a large sized butcher's chopper, the type he uses to cut pork chops with. They are up to about 14" long. You can put it on the end, then gently tap it in. Be sure the cutting edge has a large angle so it will split instead of cutting into the wood and immediately binding. We have some good experience with this chopper type. Another method is to use an old axe head you have 'glowed out' in a fire. After it has cooled, its hard, brittle edge will be lost but also the 'wedge' you now made, will not chip easily. Just put it where you want to split and tap it in using a maul or heavy hammer.
What you can also do is split through the heart to reduce weight and size, then do the rest of the work using the saw. Of course, wood full of knots is not going to split well -- but then again it will not be safe to saw up, by any method.
When splitting, consider the depth of the split. Twice as long takes more than twice the power to split. If you're making wood specimens, for example, you could cut 7" lengths and split them. However, the rest of the process would be less safe since you'll be working with quite short pieces.
Please see https://www.youtube.com/watch?v=-FjpmFwVLtM where the guy is making oversized wood samples!

10 Storage and Drying

We assume that your wood has been cut to size, sawn or split through the heart and then re-sawn. It's best practice (yes, there we go again) to seal the ends to prevent the wood from splitting by itself where you don't want any more splitting. There's special, non-toxic end sealer for sale, but some people use paint, or synthetic material like 'cheese plastic' -- a liquid that cheese is sprayed with to prevent it drying out quickly, and allows cheese to mature slowly and to good effect.

[*Fig. 12. Wood drying in a shed. The boards are separated by narrow stiles to allow circulation of air, and prevent mould. We entertained some concern about the stability of the stack in the back.]*

If you sealed the ends, drying will be slower; it will also be more predictable. You will still note that some woods behave like angels, others like devils.Make sure your wood is well aired, by using narrow stiles (and a few more sturdy ones on the floor) to keep them apart. Note that mould is not only bad for your wood, it's bad for humans as well; if you breathe in spores that can make you seriously ill.

[Fig. 13. *Very neat stack of Eucalyptus viminalis in the shed. Note that end sealer has been used. Since it's indoors, no need for an incline.]*

Wood dries quicker when some wind is blowing through the stacks; hence, in many lumber companies, the shed walls show slots to let the wind in, and out again. Don't put your wood out in the full sun (exceptions discussed below) which would make it dry too quickly, causing cupping, warping and splitting.

How thick should the boards you cut, be? That depends on
(a) What you'll be using them for and
(b) When you'll need them (see next paragraph)

Re the safety of drying

Stack your wood carefully; If you have to put it outside, put it in light shade in an airy place, and see that the outside stacks are slightly inclined: if it rains, the water will run off and not soak into your drying wood too much. If you saw your wood to just over 1" thick boards, they will, if outside, be dry in a year to eighteen months. They will shrink a little during that time. Ensure that your stack does not fall over. That would damage the wood and could endanger someone who happens to be near. Use stout stiles on thick boards, thin stiles on thin boards. Ensure the stiles are right above one another. As a general rule, put them between the boards at 2' intervals, or less if the length of the boards dictates that. It's generally best to make the stiles from the same wood you're drying. Don't use metal stiles, they can produce bad stains.
If you live in an area where storms occur, weight down the drying wood if it's outside, or *tie it down securely* to prevent your boards becoming dangerous missiles.

11 How long before it's dry?

Let's take oak for an example. Surely not the heaviest, by a long way not the lightest wood. As a thumb rule, it will take a year for every inch of thickness. Something lighter, like SPF or basswood, will dry sooner. Heavier woods (eg everything called Ironwood) will take longer. But wait a minute. *How dry is dry*? Usually we consider wood dry when its moisture content is about 20% -- or less. This is because if we store wood 'forever' in the open air but under a roof, eg in a typical lumber shed, the average mosture content over the years will be about 20%, it's called 'air dried'. However, if you're going to use the wood for eg furniture, it needs to dry more. Not longer, but in a kiln, or by being stored indoors sufficiently. Inside your house, wood may get as dry as 8% moisture content, because, especially in winter and when you use central heating, the air gets so dry. Is safety concerned here? Well, wood does not only get drier, it also

shrinks. Stacks may fall over. No kidding. And a stack falling over can do a lot of damage, usually to property. To persons, if they are in bad luck.
Therefore, if possible, don't make a very high stack of wood that you reckon is going to lose a lot of moisture -- it will be unstable.

Spring is the driest period of the year while autumn is the least dry (in the Northern Temperate Zone). So it's a good idea to fell during winter, dry during spring (if you air dry. If you kiln dry the season is not as important). If you kiln dry, beware of pushing it too hard, you might see case hardening or a lot of warping and splitting. In the old days, wood was chucked in the pond to lose much of its contents. After that, it dried quickly and was easy to saw.

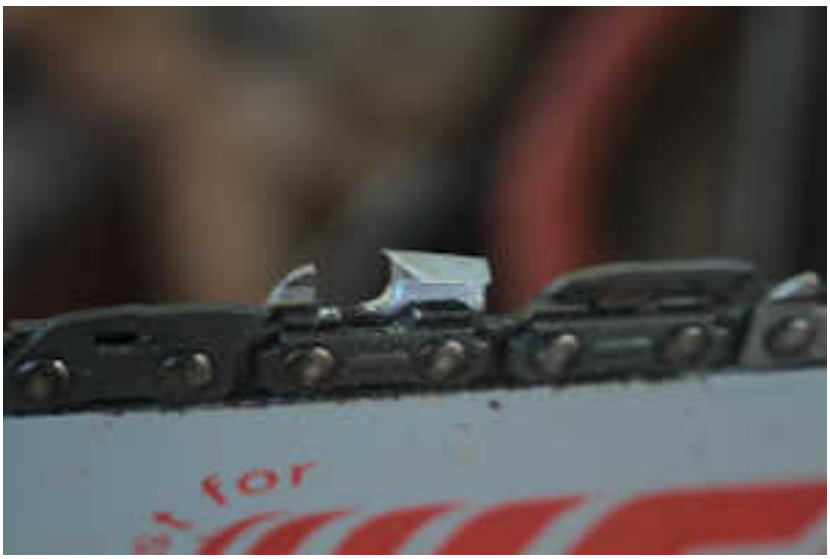


Fig.14. *Showing a well sharpened tooth on a chainsaw.*


Fig.15. *Crude shavings are proof that your chain teeth are well sharpened.*

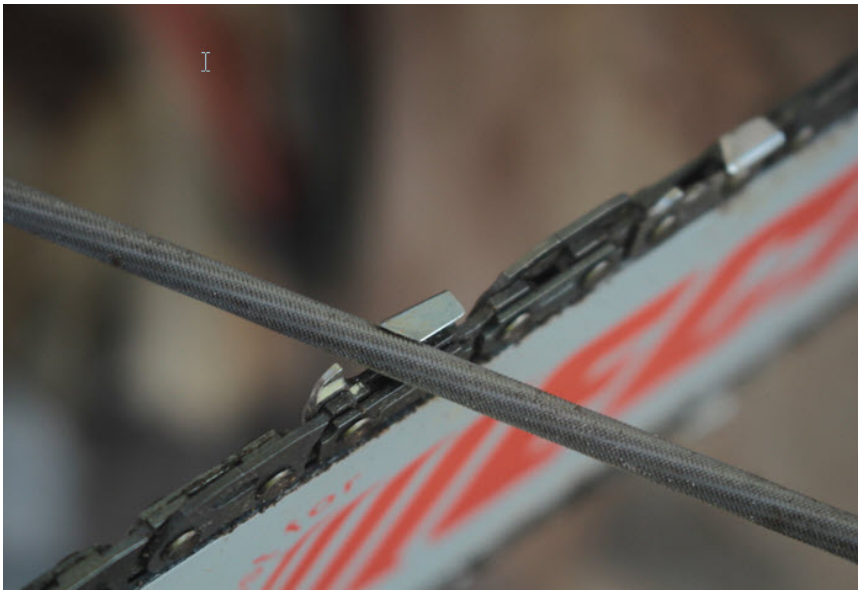


Fig.16. *Way of sharpeniung teeth on the chainsaw*

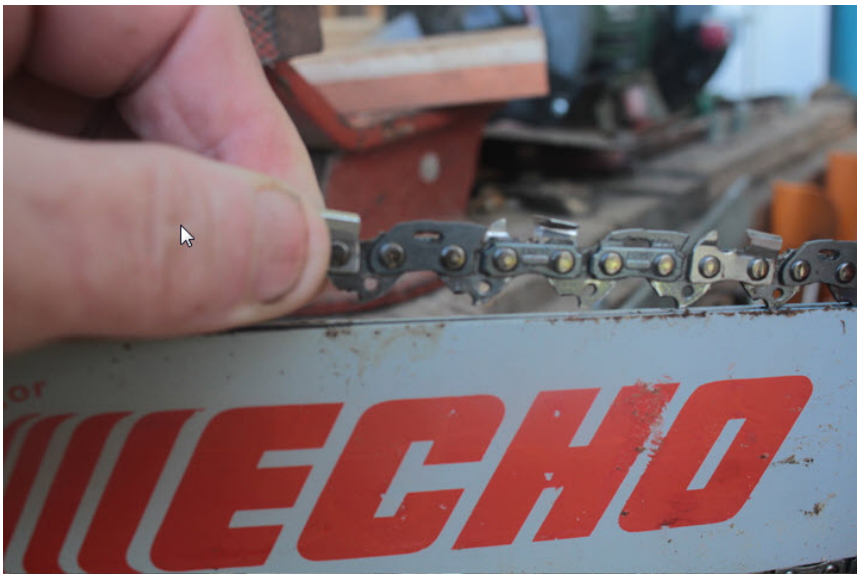


Fig.17. *Play on the chain that's really pulled up hard.*

Don't try to get your wood dry as fast as you can. Take your time to avoid warping and splitting. We promised you to get back on this subject in the above paragraph. Well, some woods are so susceptible to stain that indeed, you want them to dry as fast as you can. Generally these are very lightweight woods (tropical and temperate) and they don't warp and split a lot, even if quickly dried. With these woods, like limba (Terminalia superba) and ayous (Triplochiton scleroxylon), you can set the kiln at 'full power'.

During the drying period, wood can be susceptible to insects. These insects vary by region and also are quite variable according to the damage they do. They are generally not a safety hazard for man (the stuff you use to kill them may be).

Moulds are more dangerous in this respect but they are easy to get rid of, if you're aware they are there. Expose the wood concerned to the sun for a day and give it a good brushing. That will solve mould problems. Of course, if you did not keep the wood separated by stiles and/ or had a lot of rain combined with high temperatures, you have to find your own solution. Sometimes, washing with dilute bleach can kill

mould, but you have to rinse with a lot of water immediately after.
Remember that moulds hate sunlight and can also be detected and restrained by frequent inspection and re-stacking. Yes, that takes trouble and effort. Whether its worth while or not is yours to decide.

12 Righting your dry wood

Some time has passed and we've taken a look at our wood from time to time, and all is well (sigh of relief). Our boards are free from rot, mould and insects. Now, they will be much drier than before and if we're a bit lucky, they're straight and did not cup a lot. This is the stage where bought wood and wood harvested by yourself are coming together.
One thing you'll notice is that because it's drier, and denser, it will be harder to saw; but also harder to plane or shave. Remember to have sufficient margin for your product. On the other hand, all pieces should have a straight edge. If as a last stage you're going to pass your parts through a planer-jointer, you don't need much margin -- but a few millimetres ~1/8th of an inch may be what you want. You always lose a little thickness in thicknessing and planing.

If you bought the wood, let's hope you took a slight oversize into account -- or get it planed from the sawmill.

In case you note that some cupping or warping has taken place, you have several options. Your choice wil generally depend on how much movement there has been. And, for the sake of both safety and the end goal, you might decide you're not going to use this material after all. That can be the case where the wood has dried to a curved board or has split so much that it's really worthless. In case of slight to moderate warping and cupping your best option is often to use the circular saw to right your workpieces. If you have a bandsaw with a wide band you could use it, but remember that if your workpiece is prone to wobbling you might ruin the band -- so opt for the circular saw, or even, if the pieces are not small, a chainsaw.
Even if the material has cupped or warped a bit, you still should have a reasonably flat surface on it that it can rest on. In case of doubt, think about using the small, handheld motor planer to right one surface for a starting point.

13 Planing and thicknessing

Working at a planer-jointer is not the most exciting job -- it's a job prone to getting you bored and less aware of potential dangers. Do not fall into this trap. Take scheduled breaks and if you run out of time, continue some other day!
As we discussed above, the longer the workpiece, the safer it is at the planer-jointer or thicknesser. In case you opted for splitting again you have the choice: to split again and lose material, or to try sawing or thicknessing. If the latter, use a sturdy aid to feed the workpiece into the machine.

In case you're working on relatively large material (length and diameter) planing and thicknessing is a relatively safe and easy job. However, if the material is small, eg special wood from a shrub for samples, take due care. If at all possible, don't try to plane or thickness short material. How short? That's a matter of experience; also it may be mentioned in the manual. But generally we would recommend, not shorter than 1', when you're using a pushing aid to feed the

material. For the planer such a pushing aid would be a large block of wood, say 3" x 3"~8x8 cm at least and 2'~60 cm long, with a rabat cut out the length of your workpiece, but only a few millimetres~ 1/8" deep in case of samples production, or deeper as the required thickness of your workpiece allows.

Note that a stationary planer will happily work on green wood, while a thicknesser will not usually be safe to use on green wood. And the latter makes no sense, because you'd want the warping stage to be over before you begin righting your wood. After passing through the thicknesser, your upper and lower surfaces will be absolutely parallel. Now you can saw off wane edges, if any. here, ensure that your cut is absolutely straight. What is usually recomended is that you make 3 passes:

(a) a pass that roughly rights one side
(b) a pass that, pushing the roughly righted side along the guide rail., gives you a correctly righted opposite side, and
(c) a pass that will now finely right the side you started on.

The sides will be quite perpendicular, but they will be a bit rough. You can finish them by passing the board with its narrow side over the planer, removing very little material, 1/32" for example. In case you bought the wood only finishing in this way should normally be required and some sawyers will already have done that for you.

Safety aspects of the Planer

(a) Make sure the knives are well sharpened. The sharper they are, the safer they are. Dull knives promote kickback and put more strain on the motor. Also the surface they give you is worse. **Dull knives are probably the largest source of accidents on planers and thicknessers**. You should know how to replace dull knives with sharp ones on the cutter head. If you're new to the machine, have someone demonstrate how it goes! Always have one or even two sets of spare knives handy.
(b) Do not expose a wider section than you need -- keep the cover on the cutter head where you won't be shaving wood off. It should be able to pass through, barely. If you have large pieces the dangers are less, but don't underestimate them. We know someone who lost part of his thumb at a planer.
(c) Use a pushing aid, especially when you get near the end of your pass. Keep hands away from the cutter head.
(d) Make sure the knives are fastened sufficiently. Check often.
(e) The run-in and run-out surfaces should be very smooth. Use lubrication spray sparingly.
(f) If your workpiece has a hollow side, start planing that side. If you've planed it, work on the other side using a thicknesser.
(g) If you use the planer to right the narrow sides, make sure the guide rail is absolutely perpendicular.
(h) Remove chips by extractor or by brushing when the machine is stopped.
(i) In case of doubt, check the manual. Know the machine you're using!

Safety aspects of the thicknesser

Thicknessing does not enable you to reach the cutter head -- unless you're working on very thick pieces. If your pieces are big and long, you can start feeding by hand after which the machine takes over. Make sure, in case of large pieces, they are supported at the run-out (or have someone support their weight). In principle, a thicknesser can

reduce wood to a thickness of about 1/4". Thinner, in some species, but the forces exerted on the wood could mean that all you get is splinters. The permissible width of the workpiece equals the width of the cutting head.
Here again, use lubrication spray sparingly and make sure to remove chips often. Chips remaining in the machine can cause kickback and the surface produced will show unwanted marks.
In case you do have a kickback -- possible e.g. when the wood contains hard knots -- there will be a provision on the machine to control it. Just let it come to a halt (if it doesn't switch off automatically) and clear up the mess.

Even a very well planed or thicknessed surface can show 'machining marks', due to the fact there are not an unlimited number of knives in the cutter head, and the speed you're pushing the wood through, often automatically controlled by your machine. This is not a fault, but an intrinsic result of the process.

Note that some woods contain silica, making the knives dull rapidly. If you have to work on such woods you just have to sharpen the knives very often. Surprises and mistakes in this respect are common. Bosse, for example which looks like Sapele, is often quoted. It looks harmless enough but will get the knives dull in no time. *This affects your safety in view of what we said about the risks of dull knives*. Be informed and be aware!

14 Gluing

Even if gluing by itself usually is quite harmless, there are some glue types containing chemicals you don't want to breathe or have on your skin. On furniture you will mainly use white glue that can be diluted with water, or traditional 'hot' gelatine glues you have to boil up, the same type that makers of musical instruments use. Apart from the risk of getting fingers glued together, all seems harmless.

Well, unless you're using clamps, heavy weights or serre-joints to put pressure on the gluing surface. At the start, this will be a slippery surface (the glue can act as a lubricant before it's setting). If you use a jig or mould for gluing, you are in better control and won't generally be at risk. However, especially where pressure is concerned, do not force a tool and use sufficiently large clamps.

15 Cutting to length

The last cut on a workpiece is usually cutting to the right length (which may have to be at an angle). You can use a hand saw and mitre box or a swiveling circular saw designed for cross cutting, that generally works from above. The dangers of such a swiveling saw are more serious than those of a stationary saw, even if it's provided with a guard. Take your time making the cut which gives you more control and a better result. Don't force the saw to cut materials, or a thickness, it's not designed for. Usually, cutting woods of medium hardness is easiest. Very light woods like Balsa will often show a wooly cut, while very hard, heavy woods like ebony may show burn marks. The remedy in bnoth cases is the same: use very sharp, tungsten tipped saw blades and take it slowly.

16 Sanding

Ask yourself whether you're going to sand, or will leave the piece as is, assemble what you want to, and do the sanding after assembly. Both have their drawbacks and advantages. In case you have many similar parts to sand (like wood samples) consider using a belt sander and a jig to hold the parts. Sanding is the remedy to cover up lesser faults and it's also a great way to show off a wood's texture to best effects.
The main safety hazard here is the sawdust, so use proper extraction. If you are 'rough sanding' on a belt sander we highly recommend a jig to grip the workpiece. Sanding your skin rough at 600feet/minute is not a good idea. If you can't use dust extraction, think about sanding outdoors, using an extension cable, when there's some wind blowing. It will at least reduce exposure to dust.
The same recommendations apply to the use of a disk sander, and the type that has a cilinder with sandpaper or linen glued onto it. The main dangers are severe skin abrasion (or bad cuts on the edge). Reduce them by either putting the sander into a jig to maker it stationary, or gripping the workpiece in a vice or similar clamp. First think about how you're going to proceed -- act only after you thought it out. That saves a lot of energy, risk, and frustration.

17 General Hazards of Woodworking Machines: How To Reduce Them

In general, all machines that use sharp edges or parts revolving fast can be dangerous. No animal, including man, is by nature used to such movements. They don't exist in nature, though snapping shark and crocodile jaws come close.
Hence safe handling of such machinery has to be learned. This also applies when you just bought a new bandsaw, planer-jointer or whatever. There will be differences with the model you used before, so safety can be affected.
Of course you can subscribe to a class and train under supervision. Or ask a pro if he doesn't mind to teach you some. This is the old fashioned way. Progress may be slower than following a three-afternoon course; but that may not be so bad.

In general, the more modern a machine or tool is, the more attention the manufacturer will have given to safety. Industrial circumstances of 100 years ago differed much from those of today. Why? Laws were made to afford workers more safety, eg the laws that restrict working overtime, or long hours worked by those under adult age. Here we will recapitulate the do's and don’ts of the machines in general use.

Chainsaws

A well sharpened chainsaw is a pleasure to handle, while a dull chain makes the best saw worthless. Learn how to sharpen the chain using a hand file, because many risks are correlated to dull chains. If you buy a chainsaw the manual should mention how to sharpen the chain. After a 5 minute (or less) demonstration you'll know it as well, it's really easy. For some makes there's a jig to click the file into, for others that's not needed. Get one of reputable make like McCulloch, Homelite, Poulan or Solo, or if you live in Europe, Husqvarna, Jonsered, Stihl or an Echo from Japan. They all are as safe as a chainsaw can be and will generally give good service. Get a good quality chain as well; we can recommend Oregon.

Don't be a wimp and insist on an explanation if you buy a tool. Go to a well known and reputable shop that will also service your saw if needed. Possibly,

maintenance of your saw (not the chain) will be free during the first six months. Some makers will send their employees to a dealer for demonstrations. Re the size -- many people buy too large (and heavy) a saw. Remember that your saw will safely fell a tree about 60% more diameter than your sawblade length, so a 16"/40 cm sawblade can be used on a 2'/ 60 cm diameter tree. Also remember that working with a saw that's really too heavy will be tiring, hence dangerous, even if chainsaws now weigh only a third of what they weighed in the 1940s.
If you sharpen yourself, do it every time you fill up petrol. Yes, that can be up to about 5 to 8 times a day. But you'll immediately notice the difference. A sharp saw will bind less and be more effective. When you're used to it, sharpening the chain takes 2 to 5 minutes, maximum (depending on the # of teeth).

How easily your saw gets dull will be determined by the type of wood, how dry it is, and the presence of sand and soil. Before felling a tree it's a good idea first to brush it down. Of course you can have the chain sharpened at a dealer, but this often removes a lot of material. With practice you will see that your own sharpening skills wil surpass that of the machine. Having the chain sharpened often can cost a lot, too.

Troubleshooting:

- Bad start. A common cause is condensation in the engine because you put the saw in an unheated place, and it froze. So keep it indoors or store it in a place that's heated. With some saws, you have to use the choke or pump a few strokes before firing up. Also the spark plug could be dirty. Take it out and clean it.
- Sudden death. Plausible causes, apart from a real failure can be: --chain too tight, or you did not fill the oil reservoir. Or the oil pipe from the reservoir to the saw is blocked by particles of wood (remedy -- insert a piece of very thin wire and go back and forth. This sometimes works, depending on the make of your saw). And some saws can stop quite suddenly when the petrol has run out. Make sure you always carry ample extra fuel and oil (and a piece of wire).
- Oops!! put the wrong type of fuel in (4 stroke/ 2 stroke use different fuels). You could get lucky by flushing out with a lot of the right fuel if you know in time, but this can be an expensive mistake.
- Kickback. Caused by too much hurry (ie pressure on the sawblade), wood with soft and hard parts, insufficient tension on the chain, loss of lubrication. But the usual cause is a dull chain.
- Chain coming off. Insufficient tension. Did you tighten up the bolt(s) securing your blade well enough? Or has the chain become very hot and is now too long, through expansion? Of course, a new chain will stretch some.
- Loss of power. If gradual this can be caused by the chain getting dull, which can happen faster when you're sawing through hard knots or the wood contains silica. If your chain is the cause you will also see your chips getting more like sawdust, instead of rough chips. Or are you cross cutting with a chain designed for length cutting?
- Striking metal -- a nail, barbed wire, etc. -- or a pebble. The chain will be dull in an instant and can even break or be bent. Bad luck. Replace the chain. After some use, tighten up a little if you replaced with a *new* chain. Note that the spare chains you carry need not necessarily be new; they must be serviceable.

In case you're using an **electric chainsaw**, always store indoors. Condensation in an electric motor is very bad. A petrol engine (once thoroughly dry) will again be ready for use. An electric motor could short.

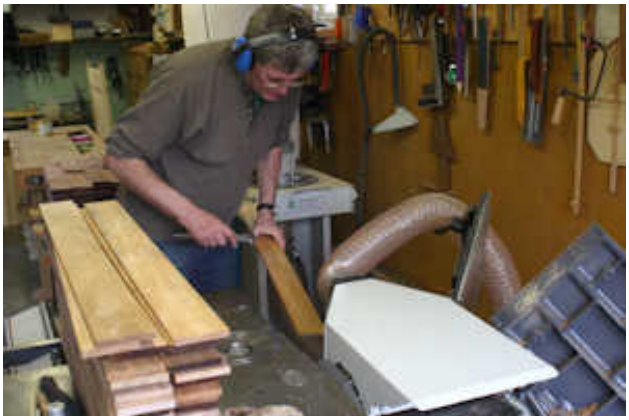
Bandsaws

Many people are more afraid of a bandsaw than of a chainsaw. The statistics tell us otherwise. An accident with a bandsaw will rarely be lethal, however stupid some people are. So is a bandsaw safe? Far from it. Any accident is no fun. The main difference, safety wise, is that the band will stay in the same place.
Even if you probably won't saw off some fingers at your leisure, an accident still is possible. Severe accidents could be caused by your clothes being seized, so wear an overall, no loose garments and tuck long hair inside the overall.

The main danger here is **when the band snaps**. When that happens it's very dangerous, the sharp teeth on the band shimmer through the air and can give you a severe injury. We once witnessed a band snapping when sawing oak wood that just happened to have an incredibly hard knot in it. The band passed over our heads and struck a merbau door where the teeth got lodged in to about 1/4" deep. If that would have been someone's arm (or worse), rushing to the nearest hospital would have been the only option, possibly after applying extensive first aid. This incident could happen because we used an antique machine on which the guards could only be set in about 1" increments. So there was about nearly an inch of clearance between the work piece and the guard. It also happened when I was 'learning on the job' with a quite proficient carpenter who heard the band make a funny sound and called out, making us step back right away. The lesson learned was that if you hear a bandsaw make any funny sound, stop it immediately and check the band thoroughly.
And, if possible, check if your line of sawing does not pass through hard knots. We were sawing oaken boards for 'rustic flooring' and were aware of the knots -- we just did not expect them to be *that hard*.
Also important -- check if you need lubrication, or not. When not in use, release some of the tension on the band, but don't forget to put it on again when starting your job.

Troubleshooting:

- Band showing a kink or crack. You'll hear when this develops, often by a rhythmic clicking sound. Stop the machine and change the band. Do not take risks deliberately.
- Band going off its course. Several causes can apply: teeth are too dull; too little tension; Trying to force the job by sawing through too much depth. Never force a band saw. Relatively, this is the most dangerous machine to force a job with.
- Upper guard too high (read above what can happen). Just a few mm ~ 1/8" of clearance is right. Measure your work piece, you don't want to stop halfway through.
- Not much progress. The teeth may be dull or the band is deviating, causing extra friction. Or are you forcing the tool? Risk of snapping! Stop the job and replace the band. Of course, if you saw particular woods, you should know they have a dulling effect on tools.



[*Fig. 18. Working with a thicknesser. Note proper dust extraction and ear protection. Checking the dimensions never hurts!]*

Planer and thicknesser

Accidents are relatively rare, but if they happen, they will be bad; lethal accidents have happened. This is caused by the sharp edges and very high RPM of the cutter head. Being seized is probably the largest risk, so wear appropriate clothes. Note that the man in the picture has rolled up his sleeves -- not a bad idea.

One well known danger, especially when you're doing serial work at a planer or thicknesser, is that after a while you get in the flow and will be less alert for danger. A common trap is not removing chips often enough. Chips will prevent workpieces sliding in and out with ease. When something gets stuck people are often tempted either to push or to pull, none of them a good idea. Stop the machine, clean out, re-set or check the settings, and continue *after a sufficient coffee break*.
Taking regular breaks here is a must, if only to check whether you may be getting tired or less alert. Don't be ashamed and take a longer break to recoup, or reserve the rest of the job for another day.

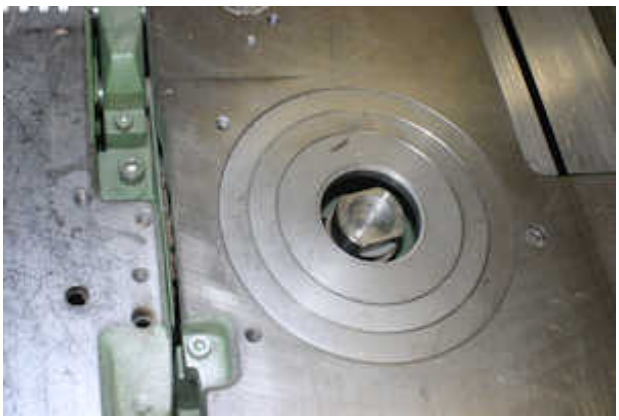
Troubleshooting:

- Workpiece getting stuck. Causes can be chips on the run-in table, knives getting dull, trying to remove too much material at one pass (ie hurry in general).
- Kickback. The machine resolves this by making splinters of the workpiece. However the root of the problem is one of the causes mentioned above -- or your workpieces may be very thin to start with. Take off even less material from the workpiece at each pass.
- Workpiece showing a ribbon at the machined face. Your knives have struck something very hard and are damaged (slightly). Re-sharpening is needed. Replace with another set of knives in the cutter head and tighten them up real well. Then first do a test run before you proceed with the job.
- Workpiece showing a groove. This can almost only be caused by a hard particle, eg a piece of knotwood, on the runoff table. If the groove is on the machined face, a particle can have become lodged between the knife and its slot but that's not normal, it should be cause for concern and *very thorough checking*.
- Rattling sounds. Stop immediately and check if any of the knives on the cutter

head is loose. If you're sure that's not the cause, use a push-through aid. If that does not solve the problem, try to remove a little more material (if you were shaving *very lightly*). Check if the same happens on another workpiece. If it does, check your manual. Possibly one of the aids catching the woods in case of kickback is out of order, or displaced. Or, counter to best practice, you are inserting workpieces with the hollow face upwards instead of down.

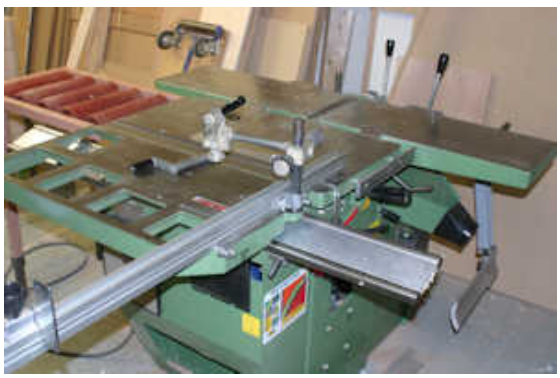
Router

We promised to tell something about routers. The procedure of routing is really a type of planing or drilling, according to the face you're working on. Routing does not produce dust, but very fine chips. Routers are characterized by their very high PM,5000 to 8000 being common.



[*Fig. 19. Router axle on a Robland combination machine. Its axle is 38 mm diameter and has two RPM settings, 3000 and 6000!]*

Probably the main risk is that of being seized. Don't wear gloves, loose fitting clothes and tuck away long hair. A router bit getting dull will, by its high RPM, quickly cause the material to burn, causing noxious fumes. That's one of the reasons why in routing, with each pass, you take off extremely little material, about 1/32" being about the maximum. Of course in industry a board goes in one side and a beautifully machined piece comes out the other -- but that's the result of a *whole series of routers*.
Routing can be excellent for truing up the sides of boards. Note that a router will cause very fine chips that you need to dispose of using dust extraction.



[Fig. 20. *Overview of a Robland combination machine: Circular saw, router, planer, thicknesser and mortise cutter.]*

While this applies to all power tools, routers are often forced. Learn how to use a router from an experienced person, or join a class which apart from teaching you something can be great fun.

Combination machines are very versatile. This versatility is at the same time

ideal and potentially dangerous. Those who buy one and are not familiar with all procedures they can be used for, should do some learning. The great advantage of these machines is their substantial weight -- hence they are stable.

Drill press

Of course, many workpieces require holes to be drilled into them -- holes to take screws or even nails if the wood is hard, or to ensure connections are at perpendicular angles. Or to take wooden pegs connecting the parts. In many respects drilling is similar to routing. The dangers, if less than those of the router, are also similar. One special safety hazard of drilling is binding, in which case your workpiece may turn round at high speed, and be damaged, or fly to pieces becoming little missiles.
Can you do something about that? Yes, you can, by paying attention to the following guidelines.

(a) secure drill bits tightly. If you use a three jaw collet, tighten all three jaws up very well. There are several holes to insert the key -- use them all.
(b) don't drill too far into hard material at one pass. Drill a little, than retreat, remove chips, and drill some more, until you drilled to the depth required.
(c) remove chips and wood dust often
(d) use only sharp drill bits. This also prevents burning/discoloration
(e) if you have to drill a very large diameter hole, pre-drill smaller guiding holes.
(f) use the right type of drill. Metal drilling requires another type than stone or wood drilling. However, if drilling very hard woods, a drill designed for metal can be appropriate.

Lathe

maybe this is the tool that at the same time can be really dangerous, but looks so awe inspiring (if it's swinging a substantial workpiece) that it's causing relatively few serious accidents. Turning wood is easy -- but getting good results is something else. Generally, a lathe is heavy; it's a stationary machine; and whether it's a wood lathe or one designed for metal working (but very capable of woodworking) it has the wonderful possibility to adjust the RPM to the perimeter of the material you're processing. Which means that hazards don't depend very much on workpiece size. That may come as a surprise to you. But consider this:
Large diameters -- few RPM and small diameters -- High RPM combinations mean that the level of hazard will, generally, be at the same level. Whereas a small object turned at high RPM, if it shatters, flies around (with little potential to pack a heavy punch), a large blank, when something fails, will just drop down -- it lacks the energy to go flying. It could badly hit your foot, though.
Richard Raffan, a famous woodturner in Australia, someone who probably put in more hours in woodturning than you think could be possible, in one of his books explains that 'the only accidents he had were breaking a bone in one of his fingers -- this happened twice.' No bad cuts, no rushes to hospital. He also explains that if you do work like this, it's not a question if an accident will heppen -- it's the question *when*. He assessed wood turning as risky, but not *very dangerous*.

Is that correct? Yes, if (a) the person doing the turning has sufficient experience -- so if you're not sure, get in a class and learn how to do it -- and use only good quality chisels.

Turning chisels should be long, they can rarely be too long. The length gives you a lot of leverage.

Of course, not all of us are lathe wizards like Richard, but then again not all of us take on projects as challenging as he does. Spindle turning is not very risky, the main danger is your chisel getting caught and kicked back a few inches. You' ll survive, although you might get bruised. So is turning on a lathe safe, as an exception? You already guessed it -- no, it isn't.

First, your chisels need to be sharpened quite often, unless you're turning only green softwoods. Sharpening chisels in theory is easy, but you can still cut yourself. This is one of the jobs where a lot of experience counts. Grinding a chisel edge without spoiling its hardened part is not a sinecure. If you get it right, you'll find your chisel cuts that much better.

Then, the pre-shaping of your blanks is a grateful subject re safety. The more corners, the more regular they are, the lower your rpm and the sharper your chisel, the safer you'll be. And avoiding risk by using a metalworker's lathe on wood is not a bad idea at all. If that lathe can swing your blank, why not? We produced beautiful bowls this way, just by gently turning the wheels. With our hands far out of the danger zone. And, need I say, with beautiful results.

Need we repeat that as with all other tools, the sharper they are (talking about the chisels now) the safer they are. A really sharp chisel does rarely 'bite into' the workpiece, given satisfactory skills by the person handling it.

Now of course there are 'special routines' like turning bowls with a narrow opening, but very much hollowed out, using a tool like the *crocodile* which is a heavy chisel with a curving cutting edge, designed to remove the wood on the inside of a bowl through the narrow opening you want to leave. Yes, this is relatively risky. And yes, it takes some learning. And it's a challenge to do this safely. And it's nice to design and make your own tools. After several years of woodturning you'd like to progress to some more technically challenging work, and test yourself to see what you can do. The results can be very satisfactory. Especially if you still have the idea that you did all you could to make the work as safe as possible.

Jigsawing machine

Unless you're really determined to break the 'stupid person' record, the jigsawing machine will be quite safe. It can be used for work like intarsia and marquetry. Of course it has a rapid motion, but it would be very hard indeed to cut off a finger -- it would take too long and hurt too much. But forcing it is easy: trying to saw through too much material, for example. Which can cause the tiny saw to fly to pieces going everywhere (did you wear eye protection!?).

18 Hand tools and Their Hazards

In a sense, hand tools are very dangerous. People stand in awe when they see a bandsaw going at full tilt, but think nothing of a hammer or axe. The edge of a

knife, adze, axe or hand plane, the teeth of a bow saw are just as keen as bandsaw teeth (or should be). The consensus is that 'anyone can use hand tools'. Well, apart from really small kids, maybe that's true.

However, people do extremely stupid and dangerous things with hand tools. Even when you're not acting foolish you can have an accident. We know someone who cut himself when sharpening an axe. In particular because there are no fast moving parts, people underestimate the dangers.
Never feel ashamed to ask for an explanation, or watch instruction videos on the internet if you're going to use your froe for the first time. There are no stupid questions (apart from asking what you already asked before); there are stupoid answers, though.
We would say that (on average, since here's a lot of variation) kids from about 12 years of age can be allowed some hand tools to work with. Depending on the tool and supervision that may be safe or unsafe.

Many dangers are due to the area where the tools are used. If at a place where a lot of other work is going on nearby, you have to make arrangements and abide them! Sawing the branches off a shrub using a bow saw is not dangerous by itself; but getting distracted while doing it can cause an accident.
You should ask yourself -- do I (or that kid) have any idea what's happening around me? Do I heed the warning of someone telling me a branch will soon be dropping down? Did I check whether other people near me have heard the warning call? Am I in a safe place when it's dropping? Do I have an escape route? What if my axe ricochets off the tree I'm felling?

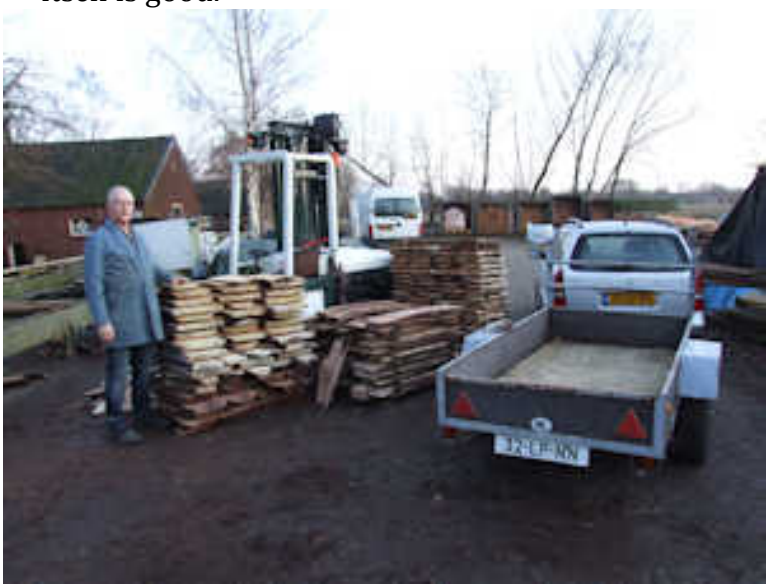
In hand tools the same rule applies as in power tools -- sharp edges are always safer then dull ones. Did you know that in case of an equally deep cut, the wound, after cutting yourself on something sharp, will heal better and quicker than after cutting yourself on something dull. Don't imagine you can't cut yourself on something dull! However, most tools come in a holster so, to keep them sharp, make sure that's where they are stored.

19 Just a little more...

The statistics tell us that, both at work, in traffic and in other activities that need concentration and attention, mistakes and accidents usually happen right at the start or near finishing time.
The first can be explained by people still being busy in their heads with their previous activity -- or being still sleepy in the early morning hours. And it just takes some time to get into the flow. Even if it makes you less alert if something unexpected happens, you yourself, and your colleagues, are less prone to do unexpected things. If you make an 'easy start' that really helps.
Now for the other end, near finishing time. People are altready thinking about their next activities -- driving home, a date with that nice lady, picking up the kids from sports class... Another major cause is working overtime. Going on, just because a job needs to be finished, even when you're really tired. This is a really dangerous trap and, when working overtime, concentration not just *can* lapse, it *will* lapse! It's not a question whether an accident will happen, but when, and

how bad it will be. People are just not able to keep up a high level of awareness and concentration for very long.
And, if you really must work overtime,

(a) plan ahead and do the less dangerous activities at the end of your working day.
(b) take regular breaks from the start. This will delay your getting tired at least a little.
(c) try to vary your activities, if possible. If you're on a two man team sawing boards on a Wood-Mizer all day, think about switching places several times.
(d) have a proper lunch break -- even if you don't want to eat a lot
(e) drink coffee, but don't overdo it.
(f) if working outdoors, be aware of the risks of exposure. Going into the forest to fell trees in winter can make a beautiful working day, but in sub-zero conditions you have to keep yourself warm. Note that one of the first signs of exposure is a reduced ability to react quickly, or assess a situation. So take a thermos bottle with hot chicken soup with you. It gives you warmth and strength at the same time and to eat it, you have to take your break which in itself is good.



[*Fig.21. Loads of wood made ready at Wim Geurts' sawmill, already loaded onto shipping pallets, ready to be transported. A load on a pallet is easy to secure, using the free spaces under the pallet.*]

Take a break, after loading up the car or trailer. Your arms will be under tension after lifting all these heavy blocks of wood. And don't hurry home, take it easy -- driving with a heavy load in the car or on the trailer requires your attention. So a coffee break before you start back home may be just what you need. We already said that planning ahead is necessary and reduces the need to hurry up.

If your work progressed better than you thought it would, be happy about it but don't be tempted to do 'just a little more'. Here we mainly mean doing activities that weren't planned -- activities planned for tomorrow, for example. Well, there is one exception -- you could ring a friend and arrange to stop at his home on the way back, and have coffee or tea together. That also gives you an extra opportunity to check how your load is holding up. A break during a long drive is always a good idea.

When working at home in the shed the same principles apply. Save some work for another day and don't be under time pressure. Make a realistic planning and when something happens unexpectedly (someone coming visiting whom you really can't send away, your dad for example) you could tell your visitor that you do have time for

her/him, but would appreciate some help with your work after having tea together.

20 Intrinsic hazards of wood

Now we'll not discuss branches dropping and the risks of tree felling, but the nature of some woods or specific trees that can produce hazards.

Some woods may be toxic. Think of woods like Poison Ivy and Manchineel or Yew. They contain poison and should, if at all, be treated with due care and circumspection. In case the botanical name ends in *toxicaria* that should make you suspicious. Mind that when sawed through or planed, wood gets hot by friction and noxious fumes can evaporate from it. This applies to all woods! Now you'll see why we talked about dust extraction several times: this also removes these fumes to a large extent.

Some woods may contain **large, hard crystals**. If you're bandsawing and hit one, you'll know for sure. The band may snap. Of course you don't have to be very afraid of this all the time, but some woods notorious for this. Get informed before sawing a wood you haven't worked with before. These crystals are often hard to detect. Much easier to detect are **knots** that some woods show. They can be soft like butter and full of liquid resin (see below) or as hard as iron. You will have to judge by yourself whether you think the wood can be processed; but at least, give it due thought. As the incident with the snapping bandsaw descibed above shows, even the experienced don't always get it right.

Woods coming from war zones (Civil War, WWI, WWII) can contain shrapnel or bullets. If your wood comes from a battle site it's probably no luxury to check with a metal detector before you start sawing. The same applies to woods that, on their surface, show **marks of grown-in objects**: pebbles and rocks, barbed wire, etc. You won't find ingrown rocks with a metal detector. Keep in mind that these ingrown objects are often in the very lowest part of the bole. You might, just possibly, want to discard that part.

Wood under tension exists because, for example, the soil had shifted when the tree was a lot smaller. The lower part of the bole shows a curve (say, the lowest 2-3 feet) while the rest is straight. if you cut well above the curving part that's about as safe as any other felling -- but it will be higher up the tree. And, if you want the 'tension wood' which may have beautiful figure, cut the stump after you felled the tree.

Wood containing resin can make your life difficult. Machinery can get stuck when cutting through a pocket of resin -- it can be like a heavy syrup and cause a lot of friction, so much friction that your saw can't take it and suddenly comes to a halt. Or serious kickcback can occur. Switch off as fast as you can, for your (electric) motor could burn. In other instances where the wood has no such pockets, but is generally resinous, your saw or its blade gradually clogs up. In the latter case you can use a little solvent like petroleum to dissolve the resin. It may mean the difference between business like almost usual, or being forced to a stop. This is a case where you should know ahead whether resin will be a problem, some woods being well known to have lots of it, especially pine species. Get informed and act accordingly.

Interlocking grain and wavy grain. This can be so bad as to prevent any thoughts of putting such wood through a saw, let alone a planer. See the picture and know what we're talking about. The problem is that interlocking or wavy grain can be difficult to detect when starting from harvested material. If you bought the wood (as in boards) this will rarely be severely wavy. Some species almost always have interlocking wood, like lignum vitae (*Guiaiacum* species) and Sapele (*Entandrophragma* species). Sawing interlocking wood on a heavy bandsaw or circular saw may not present too many problems. However, planing or thicknessing it may be problematic and can be intrinsically unsafe. Of course, in an automated process the safety aspects can be addressed, but many sawmills don't like planing or thicknessing such woods.

Being short on material. If you have ample material, you can just assign all the 'suspicious pieces' as fuel and work only on the pieces that lend themselves easily to machining. If you're a bit short you can be tempted to work on them... even if you're unsure about safety and effectivity. Don't do it!!

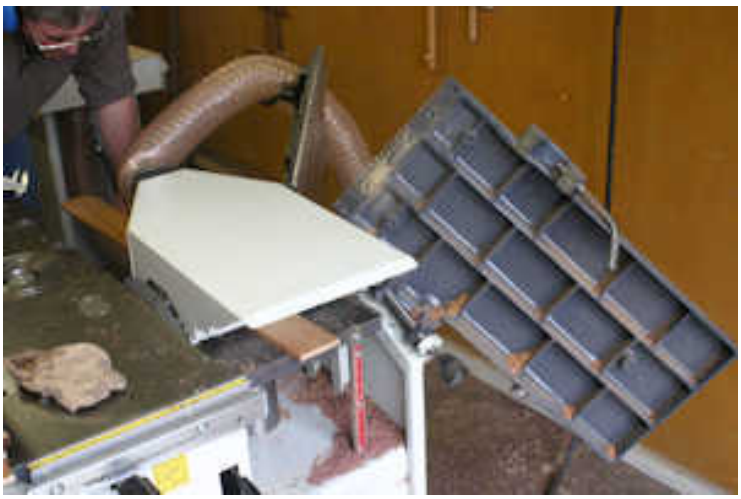
[*Fig.22. Most softwoods (except Yew which is toxic) don't present a lot of problems. They are usually easy to cut, although they may contain resin.*]

21 Epilogue and acknowledgements

We're now at the end of this safety document, and, we hope, at the start of a lot of safe work and pleasure with wood, a beautiful material that's never exactly the same. Try to follow the guidelines given. We do. Have we had accidents ourselves? Yes, some of us have. For example, one happened when the push-through stick broke while pushing a somewhat resinous board through the circular saw to cut off a wane edge. The saw just nicked a thumb, followed by some pain and a little bleeding, thanks to the length of the pushing aid. Had the pushing stick been shorter, a severe injury might have ensued. This only goes to show that even if you think you have taken the necessary precautions, the precaution itself may fail. After this happened, we sawed using much sturdier pushing aids, reducing the risk that it will happen again. But that risk, alas, will never be zero.
But in case something happens, you can at least console yourself, having done everything within reason to prevent accidents.

Does experience reduce the chance of an accident happening? Well, in some respects, yes, if you take that chance expressed in a risk per hour worked. But we'll hope you will see that if someone works hundreds of hours (getting a lot of experience) the chance of an accident (the chance per hour multiplied by the hours) still is a reality.

However, one last word about experience. Experience teaches you how to react in case an accident happens. Usually, several near misses will precede a real accident. The experienced worker knows to read the signs, to heed the warning and either change the process, refuse to continue, or re-think the path towards the end result.



A manual like this can only be written based on knowledge and experience -- not just ours. The generosity of all those who shared their knowledge without a view to profit; the discussions about what is safe, about risk and statistics have helped making this manual better than its early concepts. We have started as greenhorns ourselves and had to learn from others who did not mind our slowing down their work. Therefore we'd like to say a big THANK YOU to those who pointed the way and/ or demonstrated safe and unsafe situations and procedures to us.

[*Fig.23. Checking the thickness of the material as it leaves the thicknesser. Using ear protection and dust extraction, of course.*]

Some people deserve special mention:

- Cees Landman, Harry Wissink and Erik Both, re felling trees using chainsaws.
- Gary Green, Dennis Wilson, Dan Keierleber and Bob Chastain re discussions of Wood-Mizers, kiln drying, and specimen production
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