

nontoxicprint

Health in the Arts

LASER-CUTTING-SAFETY 3D PRINTING

Woodworking Hazards



engraving of woodworking in Germany; 1568

By Michael McCann, Ph.D., C.I.H. and Angela Babin, M.S.

Wood is one of the most commonly used material in art, crafts, and home hobbies. Wood is used for framing and installations, as well as in the creation of sculpture, furniture, crafts, jewelry, theatrical props and more. Woodworking involves techniques such as carving, laminating, joining, sawing, sanding, paint removing, and painting and finishing.

WOOD HAZARDS

Wood sculpture and furniture-making use a large number of different types of hard and soft woods, including many exotic tropical woods. Many of these woods are hazardous themselves. Sometimes woods are treated with hazardous preservatives or pesticides.

HARDWOODS

Hardwoods are commonly used in wood sculpture and furniture making. Many rare hardwoods are imported from

tropical countries. In recent years, there has been considerable controversy in the woodworking community about the ethics of using rare tropical hardwoods in sculpture because the market for them is contributing to deforestation of many parts of the world.

Hazards

1. Saps present in many green woods, and lichens and liverworts present on the surface of freshly cut wood, can cause skin allergies and irritation from direct contact.
2. Many hardwood dusts, especially those from exotic woods, are common sensitizers and can cause allergic skin reactions. Some hardwoods can cause allergic reactions in individuals working with or using finished hardwoods. Prolonged contact with rosewood, for example, which was used in making musical instruments, has caused allergic reactions in some musicians.
3. Contact with the dust of many hardwoods can cause conjunctivitis (eye inflammation), hay fever, asthma, coughing, and other respiratory diseases. Canadian and Western Red Cedar are examples.
are examples.
4. Some hardwoods can cause hypersensitivity pneumonia (alveolitis), and frequent attacks can cause permanent lung scarring (fibrosis). Examples of these highly toxic woods include giant sequoia, cork oak, some maple woods and redwood.
5. Some hardwoods contain chemicals that are toxic, and can cause a variety of symptoms, including headaches, salivation, thirst, giddiness, nausea, irregular heartbeat, etc. A classic example is hemlock.
6. Inhalation of hardwood dust is associated with a particular type of nasal and nasal sinus cancer (adenocarcinoma). This type of cancer has a latency period of 40-45 years, and occurs to the extent of about 7 in 10,000 among woodworkers who are heavily exposed. This rate is many times higher than the rate of nasal adenocarcinoma in the general population. Over half of all known cases of this type of cancer are found in woodworkers.
7. See table 1. for information on specific woods. Hardwoods such as beech and oak have been assigned a Threshold Limit Value (TLV) from the American Conference of Governmental Industrial Hygienists (ACGIH) of 1 mg/m³.

Precautions

1. Whenever possible, use common hardwoods rather than rare tropical hardwoods.
2. If you have a history of allergies, you should avoid common sensitizing woods.
3. Do not use sensitizing woods for utilitarian objects where people would be in frequent contact with the wood. For example, don't use these types of wood for handles.
4. Avoid inhalation of wood dusts by using local exhaust ventilation, or wearing a NIOSH-approved toxic dust respirator.
5. If you are handling woods that can cause skin irritation or allergies, wear gloves or apply a barrier cream. Wash hands carefully after work.
6. See also precautions for particular woodworking processes described below.

SOFTWOODS

Softwoods, for example pine, are often used in furniture making. Domestic softwoods are the most common.

Hazards

1. Softwoods do not cause as high a frequency of skin and respiratory problems as do hardwoods. A few individuals can develop allergic reactions to some softwoods.
2. It is not known whether softwood dust also causes nasal and nasal sinus cancer, since epidemiological studies involving softwood often entail exposure to hardwoods and softwoods.
3. Softwoods have been assigned a TLV of 5 mg/m³.

Precautions

1. See precautions listed for hardwoods.
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PLYWOOD AND COMPOSITION BOARD

Plywood is made by gluing thin sheets of wood together with either urea-formaldehyde glues (for indoor use) or phenol-formaldehyde glues (for outdoor use). Composition board, for example particle board, is made by gluing wood dust, chips, etc. together with urea-formaldehyde resins.

The materials can emit unreacted formaldehyde for some years after manufacture, with composition board emitting more formaldehyde. In addition, heating these materials or machining them can cause decomposition of the glue to release formaldehyde. In the last few years, manufacturers of plywood and composition boards have tried to formulate them to reduce formaldehyde emissions. However, you often have to specify low formaldehyde plywood to ensure you get the proper product.

Hazards

1. Formaldehyde is highly toxic by inhalation, highly toxic by eye contact and ingestion, and moderately toxic by skin contact. It is an irritant and strong sensitizer. Formaldehyde is a probable human carcinogen. Even trace amounts of free formaldehyde may cause allergic reactions in people who are already sensitized to it.
2. Machining, sanding, or excessive heating of plywood or composition board can cause decomposition releasing formaldehyde, carbon monoxide, hydrogen cyanide (in the case of amino resins) and phenol (in the case of phenol-formaldehyde resins).

Precautions

1. Use low-formaldehyde products whenever possible. There are particle boards that are made without formaldehyde, but these are very expensive.
 2. Do not store large amounts of plywood or composition board in the shop since it will emit formaldehyde. Instead store in a ventilated area where people do not work.
 3. Dust collectors connected to woodworking machines should be exhausted to the outside since emitted formaldehyde will not be captured by dust collectors.
 4. A gradual bakeout, in which temperatures are raised to about 90 degrees F, and contaminated air exhausted to the outside, may accelerate formaldehyde emissions in already purchased particle board and plywood, therefore reducing the exposure.
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WOOD PRESERVATIVES AND OTHER TREATMENTS

Pesticides and preservatives are often applied to wood when it is being timbered, processed or shipped. Unfortunately, it is hard to find out what chemicals, if any, have been added. This is especially a problem with imported woods, since pesticides and wood preservatives banned in the United States and Canada are often used in other countries. Pentachlorophenol and its salts, creosote, and chromated copper arsenate (CCA) have been banned for sale in the United States as wood preservatives because of their extreme hazards.

They can, however, still be found in older woods and chromated copper arsenate is still allowed as a commercial treatment (e.g. "green" lumber, playground equipment, and other outdoor uses). It is supposed to be labeled. A variety of other chemicals can be used in treating wood including fire retardants, bleaches, etc.

Hazards

1. Pentachlorophenol is highly toxic by all routes of entry. It can be absorbed through the skin, cause chloracne (a severe form of acne) and liver damage, and is a probable human carcinogen and reproductive toxin.
2. Chromated copper arsenate is extremely toxic by inhalation and ingestion, and highly toxic by skin contact. It is a known human carcinogen and teratogen. Skin contact can cause skin irritation and allergies, skin thickening and loss of skin pigmentation, ulceration, and skin cancer. Inhalation can cause respiratory irritation, and skin, lung and liver cancer. Inhalation or ingestion may cause digestive disturbances, liver damage, peripheral nervous system damage, and kidney and blood damage. Acute ingestion may be fatal.
3. Creosote has a tarry look, and is also used for outdoor wood. It is a strong skin and respiratory irritant, and is a probable human carcinogen and teratogen.
4. Zinc and copper naphthenate are slight skin irritants; copper naphthenate is moderately toxic by ingestion. If suspended in solvents, the solvent would be the main hazard.

Precautions

1. Obtain Material Safety Data Sheets on all chemicals being used in wood treatment. Treated wood itself does not

have Material Safety Data Sheets, so you have to try and find out about any treatments from the supplier. In the United States, CCA-treated wood is required to have a label and information on safe handling.

2. Do not handle woods that have been treated with pentachlorophenol or creosote. Avoid scrap or old woods of unknown origin.
 3. Do not saw, sand or otherwise machine CCA-treated wood, if at all possible. If you do, use with local exhaust ventilation or wear a NIOSH-approved respirator with high efficiency (HEPA) filters.
 4. If you add wood preservatives yourself, use zinc or copper naphthenates, if possible.
 5. Do not burn wood that has been treated with creosote, pentachlorophenol or chromated copper arsenate.
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CARVING AND MACHINING WOOD

Woods can be hand carved with chisels, rasps, files, hand saws, sandpaper, and the like, or they can be machined with electric saws, sanders, drills, lathes and other woodworking machines.

Hazards

1. As discussed in the section on Wood Hazards, many wood dusts are hazardous by skin contact or inhalation.
2. Woodworking machines are often very noisy, with noise levels ranging as high as 115 dB. This can cause permanent hearing loss with long-term exposure. The noise is often increased with old machinery with worn parts and poor maintenance.
3. Woodworking machinery and tools also present physical hazards from accidents. Machinery accidents are often due to missing machine guards, faulty equipment, or using the wrong type of machine for a particular operation. Tool accidents are often caused by dull tools or improper use.
4. Vibrating tools, for example chain saws, can cause "white fingers" (Raynaud's phenomenon) involving numbness of the fingers and hands. This can lead to permanent damage.
5. Electrical equipment can also present electrical shock and fire hazards from faulty or inadequate wiring.
6. Sawdust and wood are fire hazards. In addition, fine sawdust is an explosion hazard if enclosed.

Precautions

1. Equip woodworking machines that create substantial amounts of sawdust with dust collectors. Portable dust collectors are available that can connect to several machines. A possible alternative is to connect the machine being used to an industrial vacuum cleaner. Make sure that the connection from the dust collector to the machine is as tight as possible.

2. If you cut or machine particle board or plywood, the dust collector should be located outside.
 3. Wear a NIOSH-approved toxic dust respirator when it is not possible to use a local exhaust system.
 4. Vacuum all sawdust after work; avoid dry sweeping. Clean wood dust from around and inside machines to avoid fire hazards.
 5. Wear goggles when using machines that create dust. For lathes and similar machines which may produce wood chips, use a face shield and goggles, and make sure the machines are properly shielded.
 6. Shield noisy machines whenever possible. Mount the machinery with vibration isolators (like shock absorbers), and keep all machinery in good working condition. Replace old, noisy machinery whenever possible. Hearing protection such as ear plugs or ear muffs may be necessary.
 7. Make sure that all woodworking machines are equipped with proper guards to prevent accidents. Use the proper machine for particular operations and repair defective machines immediately. Do not wear ties, long loose hair, loose sleeves, necklaces, long earrings or other items that could catch in the machinery.
 8. Keep hand tools sharpened, and cut away from your body. Do not place your hands in front of the tool.
 9. The woodshop should be equipped with panic buttons that can shut off all machines immediately in an emergency.
 10. Keep all electrical equipment and wiring in good repair, and avoid extension cords which can be tripped over and are electrical hazards.
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GLUING WOOD

A variety of glues are used for laminating and joining wood. These include contact adhesives, casein glue, epoxy glues, formaldehyde-resin glues (e.g., formaldehyde-resorcinol), hide glues, and white glue (polyvinyl acetate emulsion), and the cyanoacrylate "instant" glues.

Hazards

1. Epoxy glues are moderately toxic by skin and eye contact, and by inhalation. Amine hardeners (as well as other types of hardeners) can cause skin allergies and irritation in a high percentage of the people using them. Inhalation can cause asthma and other lung problems.
2. Cyanoacrylate glues: These are moderately toxic by skin or eye contact. They can glue the skin together or glue the skin and other materials together, sometimes requiring surgical separation. Eye contact can cause severe eye irritation. Their long term hazards are not well studied, especially with respect to inhalation.
3. Formaldehyde-resin glues: Resorcinol-formaldehyde and urea-formaldehyde glues are highly toxic by eye contact and by inhalation, and moderately toxic by skin contact. The formaldehyde can cause skin and respiratory irritation and allergies, and is a known human carcinogen. The resin components may also cause irritation. Even when cured, any unreacted formaldehyde may cause skin irritation and sanding may cause decomposition of the glue to release formaldehyde. Formaldehyde can be a problem when working with fiber-board and plywood.
4. Contact adhesives: Extremely flammable contact adhesives contain hexane, which is highly toxic by chronic inhalation, causing peripheral nerve damage. Other solvents in contact adhesives are mineral spirits or naphtha, and

1,1,1- trichloroethane (methyl chloroform), which are moderately toxic by skin contact, inhalation and ingestion.

5. Water-based glues: Water-based contact adhesives, casein glues, hide glues, white glue (polyvinyl acetate), and other water-based adhesives are slightly toxic by skin contact, and not significantly or only slightly toxic by inhalation or ingestion.

6. Dry casein glues: These are highly toxic by inhalation or ingestion, and moderately toxic by skin contact since they often contain large amounts of sodium fluoride and strong alkalis.

Precautions

1. Avoid formaldehyde resin glues because of allergic reactions and the carcinogenicity of formaldehyde.
 2. Use water-based glues rather than solvent-type glues whenever possible.
 3. Wear gloves or barrier creams when using epoxy glues, solvent-based adhesives, or formaldehyde-resin glues.
 4. Epoxy glues, cyanoacrylate glues, and solvent-based glues should be used with good dilution ventilation, for example, a window exhaust fan. Large amounts of these glues would need local exhaust ventilation.
 5. When using solvent-based glues - particularly those with flammable solvents - do not smoke or allow open flames in the studio. Eliminate other sources of ignition in the room. 6. Wear gloves, goggles, and a NIOSH-approved toxic dust mask when mixing dry casein glues.
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PAINT STRIPPING

Stripping old paint and varnish from wood and furniture is done with paint and varnish removers containing a wide variety of solvents. One major class of paint and varnish removers formerly contained benzol (benzene). Now the benzene has been replaced with toluene. "Nonflammable" paint strippers contain methylene chloride. They may also contain many other solvents, including acetone, glycol ethers, methyl alcohol, and acetates. In recent years, a safer paint stripper based on dimethyl adipate has been developed by 3M Company. Caustic soda, acids, blowtorches and heat guns are also used to remove old paint. Old stains on wood are often removed with bleaches, which can contain caustic soda, hydrogen peroxide, oxalic acid, or hypochlorite. hydrogen peroxide, oxalic acid, or hypochlorite.

Hazards

1. Methylene chloride is highly toxic by inhalation, and moderately so by skin contact. It is converted to carbon monoxide in the body and can cause changes in heart rhythm and possible fatal heart attacks. Smokers and people with heart problems are especially at risk. Methylene chloride is also a probable human carcinogen.
2. Many of the other solvents used in paint strippers are highly or moderately toxic by inhalation, ingestion, and skin contact and/or absorption. In addition to the hazards of specific solvents, most solvents can also cause narcosis if inhaled (dizziness, fatigue, loss of coordination, nausea). Many of these solvents are also flammable. these solvents are also flammable.
3. Caustic soda used in some bleaches and for paint stripping is highly corrosive by skin or eye contact, causing severe burns. Similarly oxalic acid is corrosive. Concentrated hydrogen peroxide used in some bleaches is moderately toxic by skin or eye contact. Hypochlorite (chlorine-type) bleaches are moderately toxic by skin contact or inhalation. Mixtures of

chlorine bleaches and ammonia are highly toxic by inhalation, possibly being fatal.

4. Heat guns and torches can vaporize paint. There have been many cases of lead poisoning from using torches, and even heat guns, to remove lead-based paint.

Precautions

1. Dimethyl adipate paint strippers are safer than other solvent types because of its high boiling point, which means little evaporates.

2. Volatile, solvent-based paint strippers should preferably be used outside, unless only small amounts of stripper are being used. If used indoors, be sure to have good dilution ventilation (e.g. window exhaust fan). In small areas, or if there is not adequate ventilation, use a NIOSH-approved respirator with organic vapor cartridges.

3. Do not smoke, have open flames or other sources of ignition (e.g. pilot light) in the room if you are using flammable solvents. Solvent-soaked rags should be placed in an approved, self-closing waste disposal can which is emptied each day.

4. Wear gloves, goggles and a protective apron when handling caustic soda (sodium hydroxide), oxalic acid bleaches, or chlorine-type bleaches. An eyewash fountain and emergency shower should be available.

5. Avoid using torches to remove paint. Do not use heat guns if the paint contains lead.

PAINTING AND FINISHING

Wood can be painted with most types of paint, can be stained, lacquered, or varnished, and can be oiled with linseed oil, tung oil, or other types of oil. Other materials used in finishing include shellacs, polyurethane coatings, and waxes. Some woodworkers mix their own paints from dry pigments.

Hazards

1. Mixing paint from dry pigment can lead to possible inhalation of the pigment powder or accidental ingestion. In particular, lead chromate pigments are extremely toxic due to the risk of lung cancer.

2. Solvent-based paints, waxes, polyurethane varnishes, and wood stains commonly contain mineral spirits or turpentine, which are moderately toxic by skin contact, inhalation and ingestion. Some wood stains might also contain wood preservatives.

3. Water-based paints usually contain 5-10% solvents to help dissolve the plastic resins. These solvents include ethylene glycol, propylene glycol, and the more toxic glycol ethers. Ethylene glycol is moderately toxic by ingestion, but the amount present is small enough to make the risk negligible.

4. Shellac usually contains ethyl alcohol, which is slightly toxic by skin contact and inhalation, and sometimes methyl alcohol, which is moderately toxic by skin absorption and inhalation. Lacquers can contain more toxic solvents such as toluene, hexane, etc.

5. Most of the solvents used in varnishes, lacquers and shellacs are flammable. Paints, waxes and polyurethane coatings based on mineral spirits are combustible.

6. Tung oil, linseed oil, and most other oils have no significant toxic hazards, although a few people might develop allergies to them.

7. Oil-soaked rags and paper towels are a spontaneous combustion hazard.

Precautions

1.
Use ready-made paints rather than mixing your own. Do not eat, drink or smoke in the area where painting is done.

2.
Use water-based paints rather than solvent-based ones if possible. Use latex paints containing ethylene glycol or propylene glycol rather than glycol ethers.

3.
Use shellacs containing denatured (ethyl) alcohol rather than ones containing methyl alcohol.

4.
Wear gloves and goggles when painting or finishing.

5.
Have dilution ventilation (e.g. window exhaust fan) or do the finishing outside. If ventilation indoors is not adequate, wear a NIOSH-approved respirator with organic vapor cartridges.

6.
Finishes should be sprayed inside an explosion-proof spray booth, or wear a NIOSH-approved respirator with organic vapor cartridges and dusts and mists filters. Touchup with spray cans could be done outdoors. Brush on materials, whenever possible, to avoid the hazards of spraying.

7.
Avoid open flames, lit cigarettes and other sources of ignition in the room when applying flammable finishes, or when spraying.

8.
Store oil-soaked rags and paper towels in oily waste cans which are emptied daily. Dispose of as hazardous waste or recycle by professional laundering. A few rags can be allowed to dry on a clothesline and discarded in the trash.

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This data sheet was adapted from chapter 17 of Artist Beware.

Table 1.

TOXIC WOODS

- By Robert Woodcock,
R.N., B.S.N., C.E.N.

REACTION SITE SOURCE INCIDENCE

(GUIDE IN LETTERS)

letter abbreviations for specific hazards are given next to each kind of wood

I - irritant S - skin D - dust R - rare

S - sensitizer E - eyes W - wood C - common

C - nasopharyngeal R - resp. LB-leaves, U - unknown

cancer C - cardiac bark

P - pneumonitis, N - nausea,

alveolitis malaise

(hypersensitivity

pneumonia)

DT - direct toxin

WOOD	REACTION	SITE	POTENCY	SOURCE	INCIDENCE
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Bald Cypress	S	R	+	D	R
Balsam Fir	S	E,S	+	LB	C
Beech	S,C	E,S,R	++	LB,D	C
Birch	S	R	++	W,D	C
Black Locust	I,N	E,S	+++	LB	C
Blackwood	S	E,S	++	D,W	C
Boxwood	S	E,S	++	D,W	C
Cashew	S	E,S	+	D,W	R
Cocobolo	I,S	E,S,R	+++	D,W	C
Dahoma	I	E,S	++	D,W	C
Ebony	I,S	E,S	++	D,W	C
Elm	I	E,S	+	D	R

WOOD	REACTION	SITE	POTENCY	SOURCE	INCIDENCE
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Goncalo Aves	S	E,S	++	D,W	R
Greenheart	S	E,S	+++	D,W	C
(Surinam)					
Hemlock	C	R	?	D	U
Iroko	I,S,P	E,S,R	+++	D,W	C
Mahogany	S,P	S,R	+	D	U

(Swietenia)

Mansonia I,S E,S +++ D,W C
 N + D

Maple S,P R +++ D C

(C. Corticale mold)

Mimosa N ? LB U

Myrtle S R ++ LB,D C

Oak S E,S ++ LB,D R
 C ? D U

Obeche I,S E,S,R +++ D,W C

WOOD	REACTION	SITE	POTENCY	SOURCE	INCIDENCE
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Oleander DT N,C ++++ D,W,LB C

Olivewood I,S E,S,R +++ D,W C

Opepe S R + D R

Padauk S E,S,N + D,W R

Pau Ferro S E,S + D,W R

Peroba Rosa I R,N ++ D,W U

Purpleheart N ++ D,W C

Quebracho I R,N ++ D,LB C

C ? D U

Redwood S,P R,E,S ++ D R

C ? D U

Rosewoods I,S R,E,S ++++ D,W C

Satinwood I R,E,S +++ D,W C

Sassafras	S	R	+	D	R
	DT	N	+	D,W,LB	R
	C		?	D	U
Sequoia	I	R	+	D	R
Snakewood	I	R	++	D,W	R
Spruce	S	R	+	D,W	R
Walnut, Black	S	E,S	++	D,S	C
Wenge	S	R,E,S	++	D,W	C
Willow	S	R,N	+	D,W,LB	U
W. Red Cedar	S	R	+++	D,LB	C
Teak	S,P	E,S,R	++	D	C
Yew	I	E,S	++	D	C
	DT	N,C	++++	D,W	C
Zebrawood	S	E,S	++	D,W	R

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