A large, abstract graphic design composed of several thick, blue, geometric lines. These lines form a complex, stepped pattern that resembles a staircase or a series of interconnected paths. The lines are set against a white background and extend across most of the page's width and height. The overall effect is modern and architectural.

Today's  
**Hardboard**

# The Source

This *Introduction to Hardboard* is designed to acquaint you with this most versatile of building materials.

You may be aware of some of the many hardboard products around you. And perhaps you have already worked with hardboard, to build a birdhouse or install a "storage wall" for tools above your workbench.

But did you know, for example, that hardboard is practically a 100% wood product converted to fibers which are permanently bonded under heat and pressure into panel form?

Or that hardboard products are available in many forms other than familiar "brown board" including sophisticated woodgrains and embossed surfaces for exterior and interior uses?

Or that hardboard has superior physical properties to most materials it has replaced, and usually costs less? Look inside and learn many more interesting facts about Today's Hardboard.

## Making wood even more of a resource...

"Waste no wood" makes good sense as a battle cry for all of us concerned with ecology. It is also a basic doctrine of hardboard production in the U.S. today.

No other industry makes more *complete* use of this great American natural resource. Hardboard is made almost wholly from wood and not just from logs or roundwood. Wood chips and board trimmings, once *wastes* of the lumber industry, are now routinely saved for processing into this most versatile of home building materials.

As well as efficiently utilizing the waste products of related forest product industries, American Hardboard manufacturers maintain and manage more than one million acres of forest land in soft and hardwoods.

## How hardboard is used.

American hardboard manufacturers produce more than 7-billion square feet of hardboard every year, for a thousand-and-one different products: from prefinished wall panelings to furniture components; from today's widest choice of factory-primed and factory-finished exterior sidings to a variety of utility boards for home and industry -solid and perforated.

From do-it-yourselfers to professional builders, Today's Hardboard is a "how to" material. It is the happy medium for people who make almost anything.

## How hardboard is made.

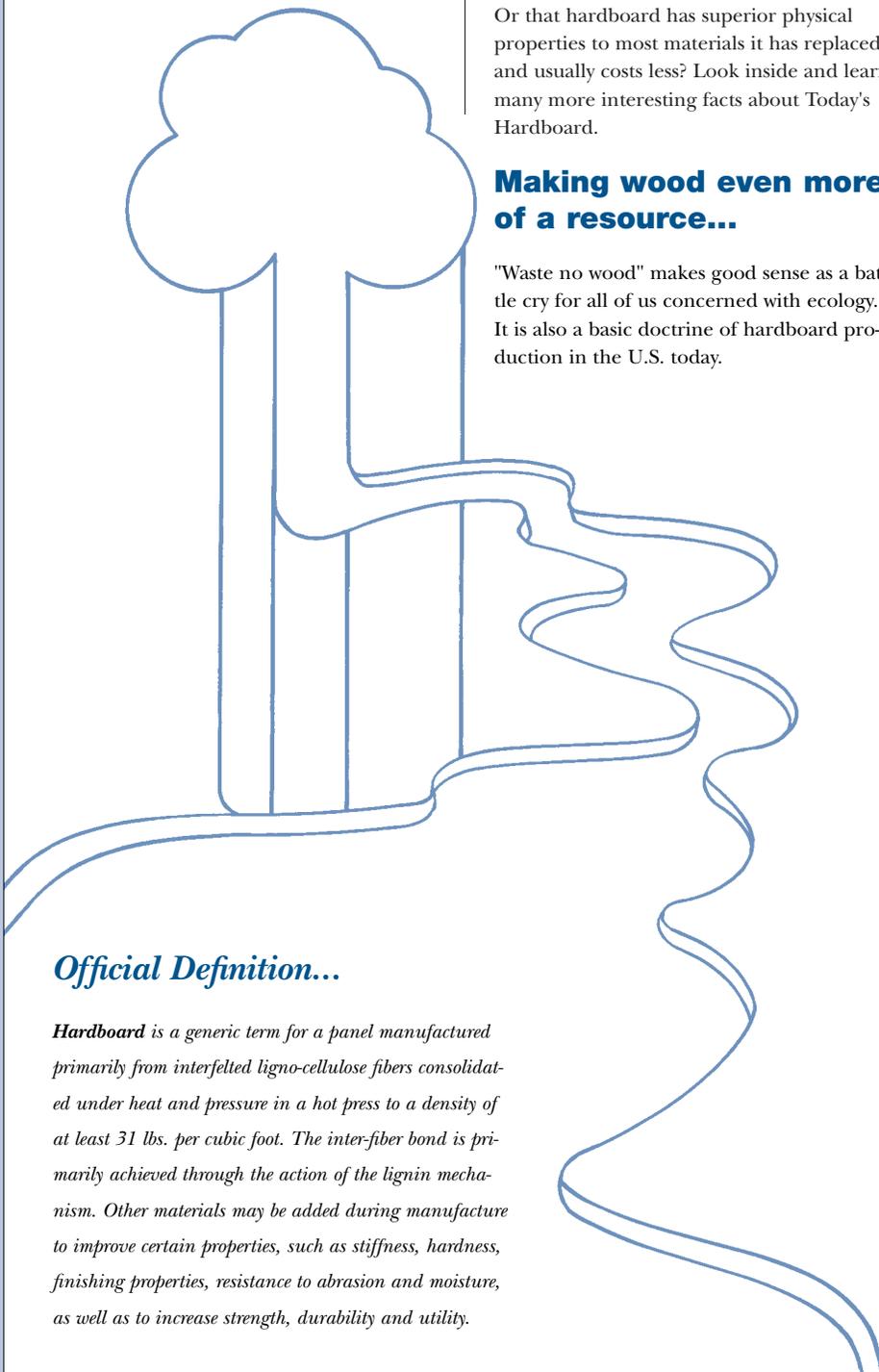
Hardboard is made from wood chips converted to fibers which are permanently bonded under heat and pressure into a panel. The wood fibers are combined with natural and synthetic binders and other additives that improve certain properties. Different hardboards have different fiber formulations, accounting for characteristic variations in product density, thickness and finishing properties, for almost unlimited uses.

Hardboard, made from wood fibers, should not be confused with *particleboard* which is made from wood chips and particles which are not refined into a distinct fiber.

Particleboard production is a "dry" process. Hardboards, on the other hand, are produced by both a "wet" or "dry" process. An abbreviated and generalized description of both processes follows.

## Official Definition...

**Hardboard** is a generic term for a panel manufactured primarily from interfelted ligno-cellulose fibers consolidated under heat and pressure in a hot press to a density of at least 31 lbs. per cubic foot. The inter-fiber bond is primarily achieved through the action of the lignin mechanism. Other materials may be added during manufacture to improve certain properties, such as stiffness, hardness, finishing properties, resistance to abrasion and moisture, as well as to increase strength, durability and utility.



## The step-by-step story of hardboard

### 1. Removing bark

Some hardboard manufacturers begin with roundwood or logs. Others start “one step ahead” with saw mill wood residues (which need no “debarking”). Still others begin the manufacturing process “two steps ahead” by using prechipped wood from other sources. In all cases, the sequence is the same, regardless of the locations in which these preparatory processes occur.

“Barking” of logs is usually desirable to insure quality control and uniformity of appearance in the finished product. It is achieved either (1) mechanically by cutting (2) hydraulically by high speed jets of water, or (3) by tumbling logs together in a large, rotating steel drum.

### 2. Reduction and preparation

Debarked roundwood or wood residues are next sent to the “chipper”, where they are reduced by whirling knives into uniform chips about the size of a man's thumbnail. (A common chip size is 5/8" wide by 3/4" long.)

Chips must be screened to prepare them for defibration. Oversized chips are returned for re-chipping. Sawdust and other fine particles are sifted and saved for use as fuel in the power plant. Acceptable chips (ready for defibration) are conveyed to storage bins. *Nothing* is wasted.

### 3. Cooking

Wood chips are cooked under heat and pressure to soften them and dissolve some of the natural resin in the wood. This allows the chips to be more easily reduced to fibers in the refining process. In the “explosion” method of digestion, the pressure is built up to high levels and then released through a quick release valve. The sudden

change in pressure between the inside and the outside of the chip causes it to explode into fiber bundles. This reduces the need for further refining.

### 4. Refining

The softened chips are fed into refiners where opposite rotating grinding disks shred them into fibers. Small amounts of chemicals may be added at this stage to improve strength and impart improved moisture resistance to the finished product. Fiber leaving the refiners is conveyed by air or water depending on the type of forming that is used.

### 5. Forming hardboard

The formation of felting of the fibers to form a mat can be achieved by either a *wet* or a *dry* process.

The *wet* process employs a continuously traveling mesh screen, onto which the soupy pulp flows rapidly and smoothly. Water is drawn off through the screen and then through a series of press rolls with wringing action similar to that of an old-fashioned washing machine.

In the *dry* felting process, comparatively dry fibers are laid out in much the same way but using air instead of a water medium. Air-formed mats emerge much thicker and softer than wetformed ones, and require more care in loading them into the press.

### 6. Pressing in hydraulic presses

From this point on, *wet* and *dry* process production procedures are virtually identical.

Pressing under heat (380°-550° F.) and pressure (500-1500 P.S.I.) puts the “hard” in

hardboard. Multiple hydraulic presses are heated by hot water, hot oil or steam. The combination of applied heat and pressure welds the fibers back together and produces properties unattainable in natural wood. The amount of press time, temperatures and pressures vary widely, depending on the process and physical properties of the board being produced. “Smooth one side” board is delivered to the presses on a wire mesh screen (hence the familiar “weave” pattern found on the reverse side of the SIS hardboard). “Smooth two sides” board (S2S) is hot-pressed between two smooth plates. All boards emerge from the hot presses with an extremely low moisture content. Some are next tempered-roll coated with oil, and baked at 290°-340° F. Tempering increases hardboard's hardness, strength and water resistance.

### 7. Humidifying

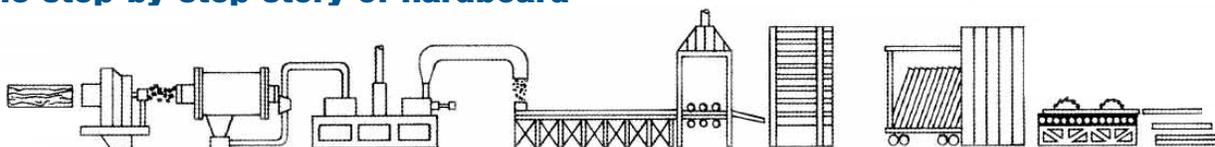
To prevent post-press warping or buckling, the boards are conveyed through a humidifier or stored on racks in a humidity chamber. This raises the moisture content to approximate atmospheric humidity. Although hardboards are humidified, they should be allowed to adjust to local atmospheric conditions before being installed.

### 8. Trimming

Tungsten carbide tipped saws trim boards to standard sizes. (True to the hardboard industry's “No Waste” philosophy, even *these* trimmings are recycled for useful purpose.) Sheets may be cut to any size a customer wants. Also, hardboard can be fabricated and finished in a variety of ways.

After all operations and final inspection have been completed, the boards are wrapped and sent to the warehouse for shipment to customers.

## The step-by-step story of hardboard



1. Removing bark 2. Reduction/  
preparation 3. Cooking  
4. Refining

5. Forming hardboard 6. Pressing 7. Humidifying 8. Trimming

# Hardboard: an extremely versatile material

## It's siding. It's paneling. And things you'd never suspect!

Of the products shown here, how many had you already associated with hardboard?

Durability, strength, surface smoothness, superb machining and finishing qualities—all help account for hardboard's unique versatility that helps make it the preferred base material for so many and diverse products.

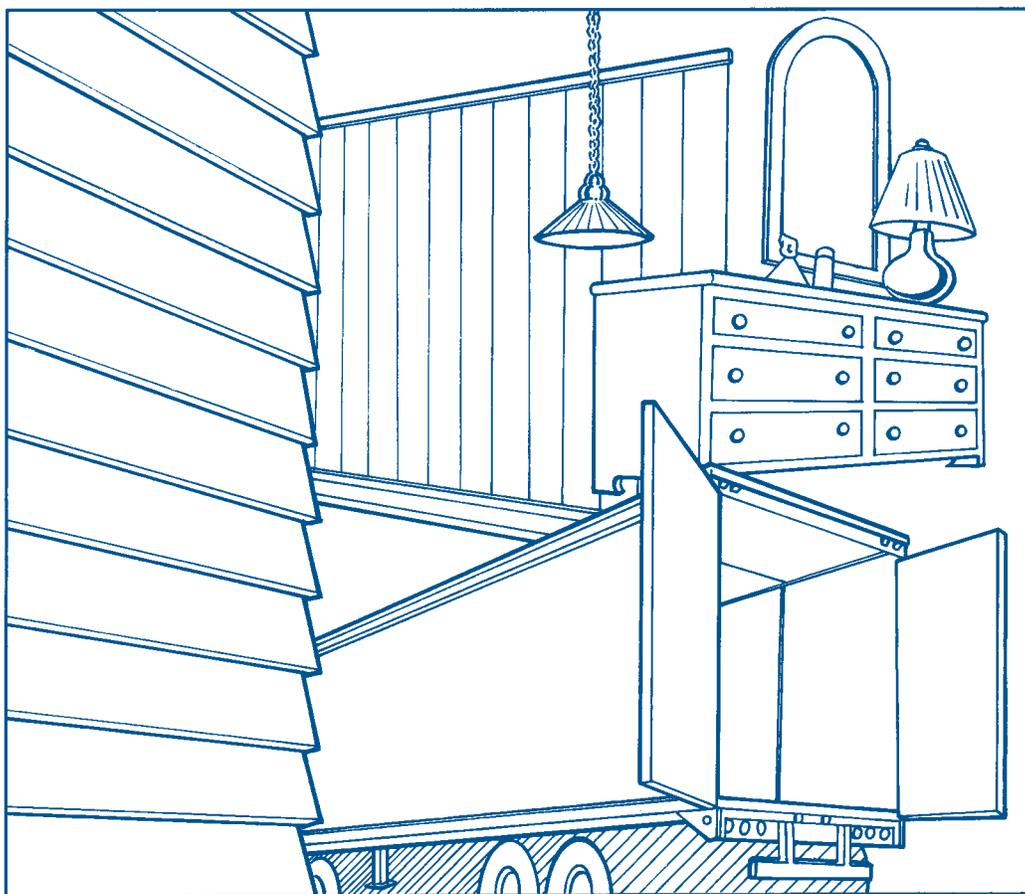
Hardboard is grainless, with *uniform* thickness, density and appearance. It resists marring, scuffing, and abrasion, as well as changes in temperature and humidity.

As a wood-base product, it follows that hardboard can be sawed, routed, shaped and drilled with standard woodworking tools. Indeed, because of its grainless uniformity of texture, working with hardboard is usually easier than working with lumber.

Hardboard can be securely glued or fastened with screws, staples or nails. Hardboard can also be laminated with plastic films, high-pressure laminates and veneers. It can even be *bent*, depending on the type of board, thickness and the radius of curvature desired.

Finishes can be applied in many ways: knife coat, roller coat, spray, curtain coat or dip. Clear or pigmented finishes include stains, penetrating sealer, shellac, latex base paints, oil base paints, textured or water-thinned paints, lacquer, synthetics and wax.

No other material is so readily available in the range of wood-grain finishes, custom patterns and mix-or-match colors that hardboard users today take for granted.



## Hardboard: A Closer Look

The uses for hardboard are diverse. It can be used wherever a dense, hard panel material in the thickness as manufactured will satisfy a performance or economical requirement better than any other material.

More and more effort is being expended by the industry to provide modifications and hardboard finishing that will permit the

material to be used in more ways at less cost for application and finishing, and to permit industrial users a saving in the final product. By the selection of fiber content and advanced engineering and production techniques, the industry's objective is to produce a hardboard that will meet and perform for a specific end use.

A knowledge of the meaning of hardboard, its physical and mechanical properties, and an awareness of the influence of these properties on its performance characteristics are important to those persons specifying and working with hardboard.

# Hardboard: a closer look

## Density and specific gravity



(Density: weight per cubic foot.)

By formula, density is expressed as:

Density (lb/ft<sup>3</sup>) =

$$\frac{\text{Weight of sample (lbs.)} \times 12}{\text{Area (ft}^2\text{)} \times \text{caliper of sample (in.)}}$$

When density is increased without any other changes, it tends to improve the following:

- Strength-improved bending, impact, tensile, internal bond, stiffness and screw holding properties.
  - Moisture resistance—An increase in density reduces the rate at which moisture can be absorbed.
  - Hardness and resistance to abrasion.
  - Machining qualities of edges and surfaces.
- A decrease in density tends to:
- Reduce weight, resulting in lower handling and shipping costs.
  - Reduce manufacturing costs on hardboards of equal caliper. Less fiber and resin are required.
  - Improve nailing and stapling.

*Specific gravity* is the ratio of the density of a material compared to the density of water.

Specific Gravity =

$$\frac{\text{Density of material (lb/ft}^3\text{)}}{\text{Density of water (lb/ft}^3\text{)}}$$

Approximate density of water = 62.5 lb/ft<sup>3</sup>

The density of hardboard is usually given as specific gravity for convenience of comparison with other materials. Because of its density hardboard is harder than most natural wood and because of its grainless character it has nearly equal properties in all directions in the plane of the board. It is not so stiff nor as strong as natural wood along the grain, but it is substantially stronger and stiffer than wood across the grain.

## Modulus of rupture

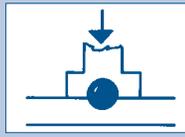


*Modulus of rupture*, the ultimate unit strength of a material in flexure or bending, has become a common measurement of hardboard strength. Even though the figure obtained is not mathematically correct, it is valuable in that it combines tensile, compressive and bending properties. It is frequently used in comparing one material with another.

MOR =

$$\frac{3 \times \text{Total Breaking Load (lbs.)} \times \text{span (in.)}}{2 \times \text{Width of Sample (in.)} \times \text{Caliper}^2 \text{ (in.)}}$$

## Hardness



(Hardness: testing for dent-resistance.)

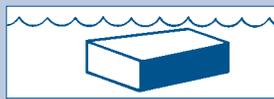
*Hardness* is determined by the modified Janka ball test: The load in pounds required to imbed a steel "ball" 0.444-inch in diameter to a depth of one-half its diameter, is the hardness value.

## Abrasion



*Abrasion* resistance is resistance afforded by a material to wear by friction. AR is not normally measured on unfinished hardboard, but can be determined by means of a Taber Abraser. This machine measures wear by standard abrasive filled wheels, and measures resistance to scratching under a known load. The weight of the abraded sample is subtracted from the initial weight of the sample to give the average weight loss in grams-per-number-of-cycles.

## Water absorption and thickness swelling



### Water absorption

(a test for resistance to moisture) is the amount of water absorbed by a submerged sample of hardboard in 24 hours. It is expressed by "percentage weight increase," according to this formula:

Water Absorption (%) =

$$\frac{(\text{Wet Weight}-\text{Initial Weight}) \times 100}{\text{Initial Weight}}$$

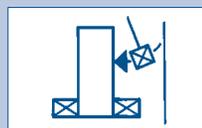
*Thickness Swelling* is the thickness increase (%) of a material after submersion in water for 24 hours. The caliper of the test sample is measured before and after submersion, after which the figures are applied to this formula:

% Swelling =

$$\frac{(\text{Wet Caliper}-\text{Initial Caliper}) \times 100}{\text{Initial Caliper}}$$

Thickness swelling is critical where hardboard is subjected to large variations in humidity or long exposure to high humidity or water.

## Impact Strength



(Testing resistance to impact.)

*Impact Strength* is resistance to fracture

under sudden localized load applied against the face of a panel held between supports. This value is usually determined by dropping a 2-inch diameter steel ball from increasing heights at the same point, the center, in the panel, until the panel fails. The height of drop in inches that produces visible failure on the opposite face is recorded as the index of resistance to impact.

## Tensile strength

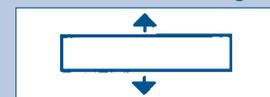


(Pulling product apart laterally.)

*Tensile strength* is the resistance of a material to being pulled apart laterally. The total applied force at the time of fracture (measured on a machine) is divided by the cross-sectional area of the sample to give ultimate tensile strength in pounds per square inch. Tensile strength =

$$\frac{\text{Total Breaking Load}}{\text{Width (in.)} \times \text{Caliper (in.)}}$$

## Internal bond strength



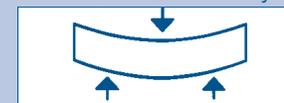
(Pulling product apart perpendicularly.)

*Bond strength* is the force that it takes to pull a material apart in a direction perpendicular to its surface. Expressed in pounds per square inch, it is the force required to fracture a 2" x 2" specimen perpendicular to the surface:

*Internal bond strength* is an important property of hardboard. Products with high bond strengths are manufactured for specific uses. Bond Strength =

$$\frac{\text{Breaking load, lbs.}}{4}$$

## Modulus of elasticity



(Stiffness or resistance to bending.)

*Modulus of elasticity* is a test of hardboard's ability to resist bending. It is determined by applying a known concentrated load midway between two supports and measuring the deflection that occurs. ME is then determined by the following formula: ME =

$$\frac{\text{Total Load (lbs.)} \times \text{Span}^3 \text{ (in.)}}{4 \times \text{Width (in.)} \times \text{Caliper}^3 \text{ (in.)} \times \text{Deflection (in.)}}$$

## Classification of hardboard by thickness and physical properties

Class	Nominal thickness	Water resistance (max av per panel)	Thickness swelling	Molulus of rupture (min av per panel)	Tensile strength (min av per panel)				
		Water absorption based on weight			Parallel to surface	Perpendicular to surface			
1 Tempered	inch 1/12	percent 30	percent 25	psi	psi	psi			
	1/10			6000	3000	130			
	1/8	25	20						
	3/16								
	1/4	20	15						
	5/16	15	10						
	3/8	10	9						
2 Standard	1/12	40	30	4500	2200	90			
	1/10								
	1/8	35	25						
	3/16								
	1/4	25	20						
	5/16	20	15						
	3/8	15	10						
3 Service-Tempered	1/8	35	30	4500	2000	75			
	3/16	30	30						
	1/4	30	25						
	3/8	20	15						
4 Service	1/8	45	35	3000	1500	50			
	3/16	40	35						
	1/4	40	30						
	3/8	35	25						
	7/16	35	25						
	1/2	30	20						
	5/8	25	20						
	11/16	25	20						
	3/4						20		
	13/16								
7/8	20	15							
1									
	1-1/8								
5 Industrialite	1/4	50	30	2000	1000	25			
	3/8	40	25						
	7/16	40	25						
	1/2	35	25						
	5/8	30	20						
	11/16	30	20						
	3/4						25		
	13/16								
	7/8	25	20						
	1								
	1-1/8								

## Thickness tolerances for hardboard panels

Nominal Thickness	Thickness Range (min.-max.)	Nominal Thickness	Thickness Range (min.-max.)
inch	inch	inch	inch
1/12 (.083)	0.070 - 0.090	1/2 (.500)	.475 - .525
1/10 (.100)	.091 - .110	5/8 (.625)	.600 - .650
1/8 (.125)	.115 - .155	11/16 (.688)	.660 - .710
3/16 (.188)	.165 - .205	3/4 (.750)	.725 - .775
1/4 (.250)	.210 - .265	13/16 (.812)	.785 - .835
5/16 (.312)	.290 - .335	7/8 (.875)	.850 - .900
3/8 (.375)	.350 - .400	1 (1.000)	.975 - 1.025
7/16 (.438)	.410 - .460	1 1/8 (1.125)	1.115 - 1.155

## Physical Properties of Hardboard Siding

Property	Requirement	
Water absorption, percent based on weight	12 (max av per panel)	
Thickness swelling, percent	8 (max av per panel)	
Weatherability of substrate (max percent residual swell)	20	
Weatherability of primed substrate	No checking, erosion, flaking or objectionable fiber raising. Adhesion less than 0.125 inch of coating "picked up"	
Linear Expansion 30-90% RH (max percent)	Thickness range	Maximum Linear expansion
	0.220-0.324	0.36
	0.325-0.375	0.38
	0.378-0.450	0.40
	over 0.451	0.40
Nail-head pull-through, lb.	150 (min av per panel)	
Lateral nail resistance, lb.	150 (min av per panel)	
Modulus of rupture, psi	1800 for 3/8 & 7/16 & 1/2 inch thick	
	3000 for 1/4 inch thick (min av per panel)	
Hardness, lb.	450 (min av per panel)	
Impact, In.	9 (min av per panel)	
Moisture content, percent	4-9 incl., and not more than 3 percent variance between any two boards in any one shipment or order.	

## Thickness tolerances for Hardboard Siding

Nominal Thickness	(min-max.)
inch	inch
1/4 (0.250)	0.220-0.265
3/8 (0.375)	0.325-0.375
7/16 (0.438)	0.376-0.450
1/2 (0.500)	0.451-0.525

## Glossary of Terms

**Standard Grade**—high strength and water resistance. Substantially same form as when it comes from press, except for humidification and trimming to size.

**Tempered Grade**—impregnated with siccativ material, stabilized by heat or processed with special additives, to impart substantially improved properties of stiffness, strength, hardness and resistance to water and abrasion, as compared with Standard.

**Service Grade**—good strength, but somewhat less strong than Standard. Substantially same form as from press, except for humidification and trimming size.

**Service-Tempered Grade**—impregnated with siccativ material, stabilized by heat or processed with special additives, to impart substantially improved properties of stiffness, strength, hardness and resistance to water and abrasion, as compared with Service.

**Industrialite Grade (Medium Density Hardboard)**—moderate strength, lower unit weight than other types.

**Smooth-one-side (S1S)**—with impression of screen on one side.

**Smooth-two-sides (S2S)**—produced from substantially dry fiber mat pressed between two smooth platens.

## Other Terms

**Patterned**—has texture of pattern pressed, punched or machined into surface; may be produced from basic hardboard.

**Embossed**—pattern impressed on one surface, such as simulated leather, wood-grain, basket weave, etc.

**Grooved**—uniform or random scoring or grooving.

**Perforated**—with factory-punched holes; may be used for displays or to provide decorative wall-mounted storage facility, or for acoustical purposes.

**Thickness**—shown in accompanying tables.

**Face Dimensions**—panels generally are 4 and 5 ft. wide. Lengths are generally up to 16 ft.

## Other Commercial Products

**Laminated**—using an adhesive between multiple plies to obtain greater thickness.

**Primed or Coated**—with paint or other coating applied to discernible film thickness for decorative purpose or as base for further finishing.

**Factory-Sealed (or Factory-Filled)**—with sealer (or filler) incorporated in board surface for improved smoothness, finishing characteristics and/or decorative purposes.

**Decorative Overlaid**—on which a film or sheet has been laminated; solid color, wood-grain or other design.

**Core**—for high-pressure decorative plastic laminates, or for low-pressure plastic or veneer laminates. Characterized by good perpendicular tensile strength, machinability, smooth surface. Usually sanded for uniform thickness.

**Die-Formed**—hardboard molded between male and female dies.

**Surface High Density**—usually in density ranges of 80-90 lb/cu. ft. Available in heavier thickness and in single or multiple plies laminated with reinforced thermosetting bond. Usually S2S and treated for special electrical and machining properties. Generally has hard surface, low water absorption, high modulus of rupture.

**Lap Siding**—after installation, yields a pattern of horizontal planks. This siding may be embossed, grooved, and/or smooth on the face. Normally available in strips 16 feet long.

**Panel Siding**—after installation, yields a flush surface. This siding may be either embossed, grooved, and/or smooth on the face. Panels normally available sized 4 feet by 8 feet.

## Publications

AHA list of publications includes the following:

* Today's Hardboard	ANSI Standard ANSI/AHA A135.4
* Recommended Basic Application and Painting Instructions for Hardboard Siding	Basic Hardboard-\$4.00 ANSI Standard ANSI/AHA A135.5 Hardboard Paneling-\$4.00
* Maintenance Tips for Hardboard Siding	ANSI Standard ANSI/AHA A135.6
* Basic Hardboard Products	Hardboard Siding-\$6.00

## About The American Hardboard Association

The American Hardboard Association is the national trade organization representing manufacturers of hardboard products used for exterior siding, interior wall paneling, household and commercial furniture, and industrial and commercial products. AHA serves as the central clearing house on industry and technical information for architects, builders, contractors, distributors, dealers, government agencies and the general public. The Association is concerned with statistical reports, standard/specification programs, research activities, building codes, environmental affairs, educational publications, manufacturing and safety activities and governmental relations. The Association also administers a quality conformance program for hardboard siding.



For additional information and literature, contact:

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One South Wacker Drive  
Chicago, Illinois 60606  
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**Stimson Lumber Company  
Hardboard Operations**  
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Forest Grove, Oregon 97116  
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Fax: (503) 359-3400

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Diboll, Texas 75941  
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