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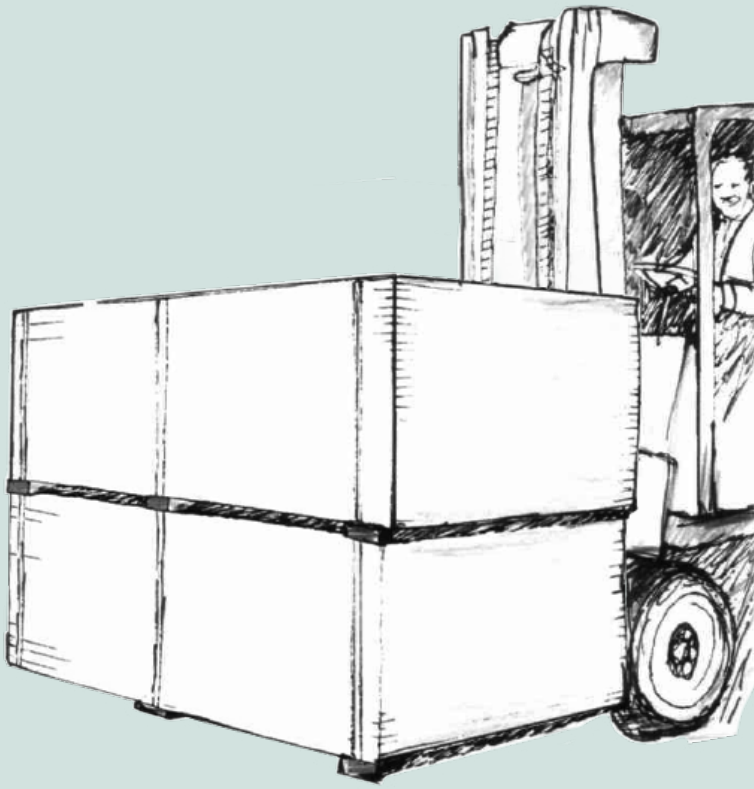
Technical Bulletin

Storage and Handling of **Particleboard and MDF**

COMPOSITE PANEL ASSOCIATION

Introduction

Composite panels include medium density fiberboard (MDF) and particleboard, and can be wood or agricultural fiber (agrifiber) based. All types of composite panels will perform better if properly handled and stored.



Packaging

Manufacturers offer a wide range of protective packaging. Typically, each unit or bundle of panels is banded with straps wrapped around bottom bolsters, with corner protectors on the top, and in some cases protective waste strips, pieces or panels on the top and/or bottom of the units. The bolsters permit forklift handling of the units and, along with the protective waste pieces, protect outer panels from damage.

Composite panels may be packaged in different unit sizes. Order smaller units if you do not have sufficient forklift capacity to handle the weight of larger ones. Particleboard densities typically range from 38 to 55 pounds per cubic foot (609 to 881 kg per cubic meter). MDF densities range from 35 to 60 pounds per cubic foot (561 to 961 kg per cubic meter).

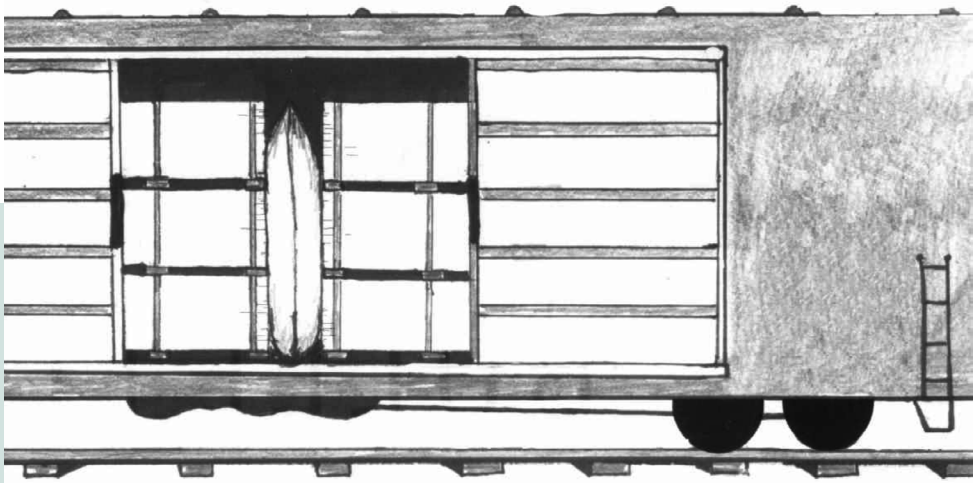
STANDARD UNIT SIZES	TYPICAL WEIGHTS
4' x 8' x 25"h.	About 3,000 lbs*
4' x 8' x 32"h.	About 4,000 lbs*
1220 mm x 2440 mm x 635 mm	1,400 kg*
1220 mm x 2440 mm x 813 mm	1,800 kg*

**Based on 45 pounds per cubic foot density*

Oversized Panels

It is common practice to purchase "industrial" panels in oversized dimensions for laminating applications, about 1" (25 mm) extra in length and width. This permits the trimming of laminated panels to net finished sizes that are closer to nominal dimensions. Over sizing of panels also allows for the trimming of minor edge and end damage that can occur during handling.

INSPECT FOR STORAGE



Producers make every effort to block loads securely with either timbers, dunnage boards or airbags. The illustration to the left shows when an airbag is used to transport units by railcar.

Inspection

Effective storage and handling should begin with a critical observation of inbound shipments to ensure that units were not damaged or exposed to wetting or contamination during shipment. When shipping by truck, tarpaulins should be properly attached and contain no gaps or punctures.

If deflated airbags, water from leaking doors or improperly applied tarpaulins, or any damage is observed, photograph the problem before unloading the shipment in order to document any claims that may need to be filed. Record the conditions on the bill of lading and/ or other order documentation, then contact the delivering carrier promptly to report the problem. Contact the panel supplier for assistance if there are problems in settling the claim.

Unloading

Unload panel units under protective cover if possible. Placards on railcars typically indicate the side from which units should be unloaded. In order to avoid damage, cars should be unloaded from the side originally loaded.

If unloaded outdoors, material should be moved under cover as soon as possible. Avoid unloading outdoors during inclement weather or under windy conditions.

Damage Caused by Exposure to Water or High Humidity

Today's laminates require smooth surfaces for their application. Most particleboard and MDF products are produced with interior use glues and are not designed to get wet. Therefore, to ensure the best surface quality of panels, units should be protected against exposure to both water and high humidity. Products can be produced with glues having varying degrees of moisture resistance. Nevertheless, the smoothness and appearance of most surfaces that do not have a protective coating will characteristically be affected by moisture.

The effect of water or high humidity on any product is directly related to the severity and length of the exposure. Tight straps, which may be indenting the upper corners of a bundle, are an indicator of built-up stresses induced by exposure to high humidity. Corner protectors on the tops of bundles will minimize such damage.

While only the top and bottom panels of units have their surfaces exposed to the atmosphere, each panel has all four edges exposed. Most panels tend to absorb moisture into their edges more rapidly than through the panel surfaces. This unequal rate of moisture absorption can cause unequal stresses to build in the panels that will be relieved when

the panels are cut. These differential stresses can become obvious when the panels are cut into long narrow strips. As the stresses are relieved through cutting, the strips from the outer edges of the panels may bend, creating what is commonly referred to as a "banana" cut. Allowing the cut part to come to equilibrium will normally straighten these panel strips. (Cutting panels before they are completely cooled may also result in banana cuts.)

Storage

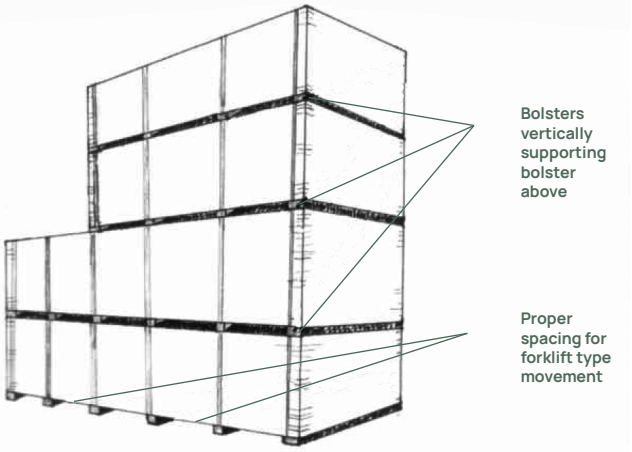
For reasons mentioned above, composite panels should never be stored outdoors. Indoor storage areas should be clean, dry, well ventilated, and isolated from machining operations that create dust, dirt, or airborne particulates that could soil or contaminate the panels. Panels to be laminated are affected by sunlight, which can have a negative effect on some glue bonds and change the color of wood.

Stacking

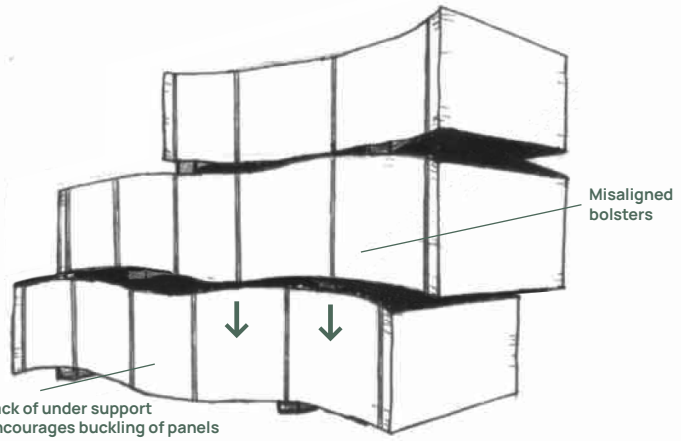
Panels are usually stacked in the storage area by unit sizes. Units should be stacked carefully and in alignment to keep aisles clear. Stacks should be limited to five units in height. Stack height may also be dependent on the lifting capacity of the forklift, ceiling height, available floor space, and the load-bearing capacity of the floor.

It is important to stack panel units on a hard, level surface. For example, 4' x 8' x 32" (1220 mm x 2440 mm x 813 mm) five units correctly stacked and weighing a total of 10 short tons (9 metric tons) (if the panels have density of 45 pounds per cubic foot) will exert an average of 3.2 short tons (3 metric tons) on each of 3 bottom support bolsters. Bolsters for a given unit must all be of equal thickness. Arrange stacks so that bolsters and top protective strips are aligned and overall stacks are as square as possible. The weight of several thousand pounds of material on panels with misaligned, uneven, or missing support bolsters can cause high bending stresses which could in turn result in a permanent set in the panel, warping and/or panel damage.

CORRECT STORAGE



INCORRECT STORAGE



Cut-to-Size Panels

Stacking shipments of cut-to-size panels also requires proper alignment of bolsters and of top protective pieces to ensure uniform load distribution.

Cut-to-size panels should be kept off the floor, and the sequence of panel sizes should be arranged for uniform alignment and proper support from bolsters.

It is a good idea to use 3/4 inch (19 mm) or thicker bottom boards for component storage. Large sheets are often used for top and bottom boards to protect and consolidate smaller pieces.

Contamination Control

Contamination of board surfaces can cause gluing, laminating and finishing difficulties. The storage area should be isolated from air currents carrying sander dust, dirt, and other particulates. An effective dust-collection system and good housekeeping practices in the storage area will minimize the potential for contamination.

Oil and grease contamination can usually be avoided with good housekeeping and forklift maintenance practices.

Inventory Control

It is good practice to use material on a first-in-first out basis to minimize the potential for contamination and damage.

Composite panels are stable products but, like all wood products, performance can be affected by storage conditions. Wood based products, including composite panels are hygroscopic and will undergo a slight change in dimension as they gain or lose moisture. The temperature at which they are stored or used can also affect these products.

Materials slated for gluing, laminating or other finishing processes may need a week or more before coming to temperature and moisture content equilibrium. Such materials should be "conditioned" by separating the panels with clean, dry spacer sticks or by placing panels in a spacing rack to provide good air circulation across all surfaces. This will facilitate rapid and uniform conditioning.

The table below shows the moisture content that most wood species will attain at different relative humidities and temperatures. For example, at 70°F (21°C) and 50% relative humidity, the equilibrium moisture content will be 9.2%.

Moisture Content of Solid Wood With Temperature/Relative Humidity *

Temperature		Moisture Content (%) at Various Relative Humidities																		
°F	°C	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30	(-1.1)	1.4	2.6	3.7	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.4	11.3	12.4	13.5	14.9	16.5	18.5	21.0	24.3
40	(4.4)	1.4	2.6	3.7	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.4	11.3	12.3	13.5	14.9	16.5	18.5	21.0	24.3
50	(10.0)	1.4	2.6	3.6	4.6	5.5	6.3	7.1	7.9	8.7	9.5	10.3	11.2	12.3	13.4	14.8	16.4	18.4	20.9	24.3
60	(15.6)	1.3	2.5	3.6	4.6	5.4	6.2	7.0	7.8	8.6	9.4	10.2	11.1	12.1	13.3	14.6	16.2	18.2	20.7	24.1
70	(21.1)	1.3	2.5	3.5	4.5	5.4	6.2	6.9	7.7	8.5	9.2	10.1	11.0	12.0	13.1	14.4	16.0	17.9	20.5	23.9
80	(26.7)	1.3	2.4	3.5	4.4	5.3	6.1	6.8	7.6	8.3	9.1	9.9	10.8	11.7	12.9	14.2	15.7	17.7	20.2	23.6
90	(32.2)	1.2	2.3	3.4	4.3	5.1	5.9	6.7	7.4	8.1	8.9	9.7	10.5	11.5	12.6	13.9	15.4	17.3	19.8	23.3
100	(37.8)	1.2	2.3	3.3	4.2	5.0	5.8	6.5	7.2	7.9	8.7	9.5	10.3	11.2	12.3	13.6	15.1	17.0	19.5	22.9
110	(43.3)	1.1	2.2	3.2	4.0	4.9	5.6	6.3	7.0	7.7	8.4	9.2	10.0	11.0	12.0	13.2	14.7	16.6	19.1	22.4
120	(48.9)	1.1	2.1	3.0	3.9	4.7	5.4	6.1	6.8	7.5	8.2	8.9	9.7	10.6	11.7	12.9	14.4	16.2	18.6	22.0

**Composite panels will typically have 1% to 2% lower moisture content at a given temperature and humidity*
Source: USDA Forest Service Wood Handbook No. FPL-GTR-113

Panel Conditioning

Temperature and Its Effects

Temperature should be kept as close to 70°F (21°C) as possible. Avoid storage in extremely hot or cold temperatures as such conditions could adversely affect moisture content and surface quality of panel products for subsequent gluing, laminating, and finishing processes.

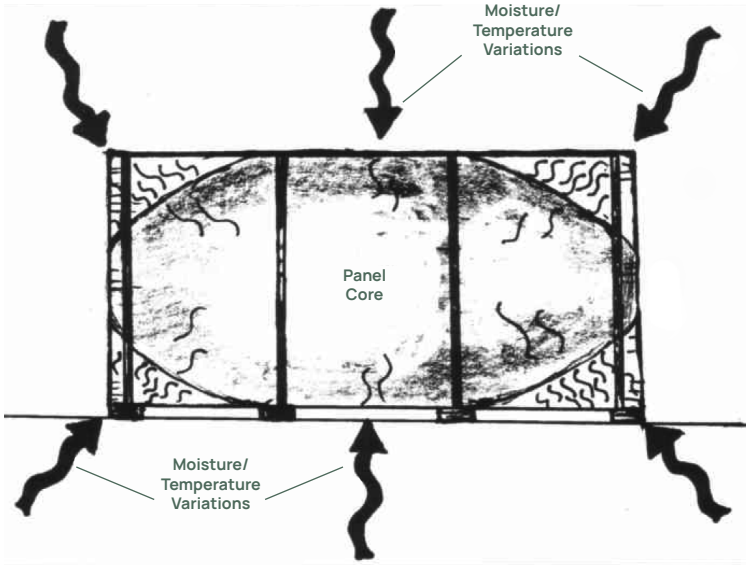
It may take several days for panels to come to temperature equilibrium. Warming panels in winter takes just as long as cooling them in summer. The top few panels may feel comfortable to the touch but the middle of the unit could be either hot or cold, depending on the season.

Cold panel and/or cold ambient temperatures will slow the cure rate of adhesives used in lamination.

Winter shipments tend to be more troublesome than summer shipments for some manufacturers because of the high internal panel temperatures (post manufacturing) and the much cooler temperatures and/or lower humidity in boxcars or on trucks during shipping. As panel units cool from the outside in, top and bottom panel warping can occur as a result of colder outer temperatures vs. warmer inner temperatures. Another common problem is the condensation of water on panel products thicker than 1-inch (25 mm) when they are stacked together tightly.

In winter, cold material may require a warmup period before use. Conversely, in summer, hot material may require cooling before it is used. If this is not possible, it may be necessary to modify other process variables, such as adhesive formulation or press cycles. It is always a good practice to allow materials to come to temperature equilibrium before they are used.

MOISTURE CONTENT AND TEMPERATURE EQUALIZE SLOWER NEAR THE CENTER OF PANEL UNIT



Relative Humidity

Relative humidity is defined as a ratio of the amount of water vapor present in the air to that which the air would hold at saturation at the same temperature. This is expressed as a percentage. Any wood product will lose or gain moisture from the surrounding atmosphere until the amount of moisture in the wood balances with the temperature and relative humidity in the atmosphere of the room or area where it is located. Composite panels, laminates, and other materials that are to be combined in gluing, laminating or finishing processes should ideally be conditioned at 35% to 45% relative humidity and 70° F (21°C) prior to use.

Panel Conditioning

Equilibrium Moisture Content

The moisture content at which wood neither gains nor loses moisture when surrounded by air at a given relative humidity and temperature is known as the equilibrium moisture content (EMC).

The moisture content of composite panels can affect panel gluing, finishing, and dimensional stability. Poor adhesive bonds, poor finish quality, steam blows, surface roughening, moderate swelling or shrinkage, unbalanced panel construction, and face checking of laminated veneers can occur if panel moisture content is too high or too low. Variations in wood moisture content can be minimized if panels are held within desired limits by controlling the temperature, relative humidity, and rate of air movement in the storage area.

Dimensional changes may occur in small parts that are cut or routed exactly to size if left in areas of high relative humidity. The dimensions of such small parts may experience undesirable changes when stored for a few days in areas with a relative humidity of 80% or higher, rendering those parts unusable. Precision part runs should either be or stored at 35 to 50% RH in order to minimize dimensional changes, or used as soon as possible after cutting.

Measuring Moisture Content

Moisture content is defined as the amount of water expressed as a percentage of the weight of the wood dried in an oven for 24 hours between 214°F (101 °C) and 221° F (105°C). For example, a sample that weighed 105 grams (3.70 oz) before drying and 100 grams (3.53 oz) after drying would have a moisture content of 5%. Oven drying is the test method used by manufacturers for determining moisture content, and it is also universally accepted by the forest products industry.

A small oven-drying unit can be established on-site to accurately measure moisture content.

The use of electronic or other direct reading methods (e.g.; moisture meters) is not recommended as adhesives and other additives in composite panels can alter meter readings.

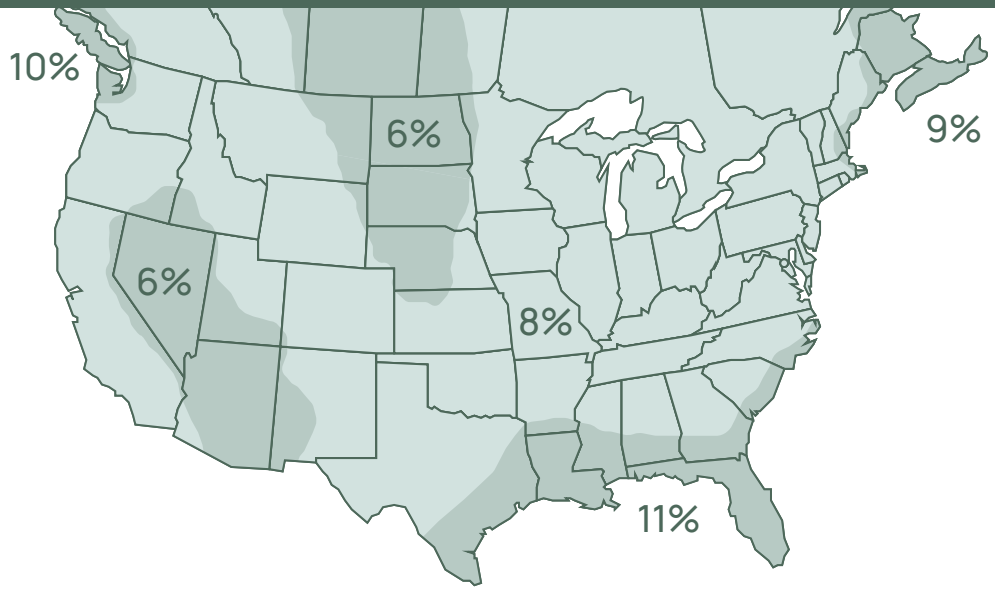
Controlling Moisture Content

For optimum panel finishing and fabrication, composite panels and laminate materials should be conditioned at 35% to 45% relative humidity and 70°F (21 °C) to achieve an equilibrium moisture content (EMC) between 5% and 9%. If it is impractical to establish an acceptable EMC range in the main storage area, smaller, separate storage or conditioning area may be required. In-service dimensional stability is best achieved when:

1. The moisture content of panels and laminate materials are in the same range at the time of fabrication.
2. The moisture content of the finished product is approximately the same as the moisture content to be encountered in service.

Panel Conditioning

AVERAGE INTERIOR MOISTURE CONTENT



Source: USDA Forest Service Wood Handbook No. 721, modified to include Canada

Through experience, some fabricators have found that conditioning of panels may not be required for some processing phases. For best results, however, it is always good practice to have materials enter the manufacturing area at a temperature in the range of 60° to 80°F (16° to 27°C) and a moisture content in the range of 5% to 9%.

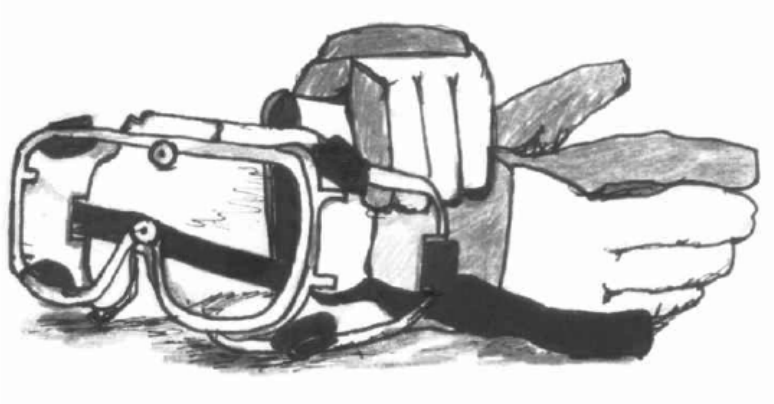
When temperature extremes exist during shipment it can require several days for the center panels of large units to equalize to storage area temperatures. Residual shipment temperatures can be especially important for just-in-time shipments, and adequate conditioning time should be scheduled into the fabrication process. Boxcars and trucks typically do not have environmental controls. Therefore, panel strapping should be cut upon arrival, and the units divided into smaller bundles for quicker conditioning. The smaller units should be stacked, aligned and supported with bolsters. The map above shows the average interior moisture content to which wood will equalize in North America.

Safety

Workers should wear the following minimum equipment before cutting or sanding wood products: a NIOSH-approved half-mask respirator (filter) that has a HEPA filter rating printed on the package, side-shielded safety glasses, a long-sleeved shirt, and gloves.

Composite products are biodegradable. Follow state, local and federal regulations for the disposal of residue and waste from composite panels.

For further safety information refer to the Safety Data Sheet (SDS) provided by the panel manufacturer.



Summary

Key material handling and storage criteria to ensure optimal performance of composite panels:

- *Avoid exposure to water and high humidity.*
- *Store indoors in a dry, well-ventilated area away from production lines.*
- *Keep material off the floor. Stack panel units on a hard, level surface. Support cut-to-size panels with additional 3/ 4" (19 mm) thick bottom boards.*
- *Use same thickness bolsters that are properly aligned with top strips for uniform load distribution.*
- *Limit storage stack height to 5 units.*
- *Avoid extremes in temperature during storage and fabrication.*
- *For optimum performance, condition materials at 35% to 45% relative humidity and 70°F (21 °C) to achieve an EMC between 5% and 9% before use.*

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About CPA

The Composite Panel Association (CPA), founded in 1960, represents the North American wood-based composite panel and decorative surfacing industries on technical, public policy, quality assurance and product acceptance issues. CPA General Members include the leading manufacturers of particleboard, medium density fiberboard (MDF), engineered wood siding and trim and hardboard in North America, representing more than 90% of industry manufacturing capacity. CPA Associate Members include manufacturers of decorative surfaces, furniture, cabinets, mouldings, doors and equipment, along with laminators, distributors, industry media and adhesive suppliers committed to product advancement and industry competitiveness. CPA is a vital resource for specifiers, manufacturers and users of industry products. The association provides leadership on federal, state and provincial regulatory and legislative matters of interest to industry. As an internationally recognized and accredited standards developer, CPA writes, publishes and maintains the industry's definitive ANSI product standards. CPA also operates the International Testing Center (ITC) and manages the Grademark Certification Program, the largest and most stringent testing and certification program of its kind for North American composite panel products. CPA developed the Eco-Certified Composite (ECC) Sustainability Standard and Certification Program, a voluntary industry standard for composite wood panels and finished products made with particleboard, MDF, hardboard and engineered wood siding and trim.

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