



TECHNICAL NOTE

Formaldehyde Emissions  
from  
Plywood and Laminated Veneer Lumber



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## Scope and Abstract

This statement has been developed in response to concerns expressed as a result of the recent review of formaldehyde toxicology carried out by the International Agency for Research on Cancer.

This statement summarises the results of on-going industry wide testing of formaldehyde emissions from EWPAAs branded products.

This survey has shown that emissions from Type A bonded products (phenolic adhesives) representing over 90% of EWPAAs production are effectively zero. Emissions from the remaining 10% non A bonded products (amino plastic) are low and meet the stringent European E<sub>1</sub> regulation.

## What is Formaldehyde ?

Formaldehyde is a colourless strong smelling gas. Formaldehyde occurs naturally in the environment and is emitted by processes such as combustion, decay and is emitted naturally by all timber species.

Formaldehyde is present in exhaust fumes, wood smoke, tobacco smoke and is produced by domestic appliances such as combustion heaters.

Formaldehyde is present in the air that we breathe at natural background levels of about 0.03 parts per million (ppm) with recent studies showing formaldehyde concentrations often up to 0.08ppm in outdoor urban air.

Formaldehyde is industrially significant with the downstream use of formaldehyde based inputs contributing approximately 8% to US gross domestic product.

Formaldehyde is used as an ingredient in synthetic resins, industrial chemicals, preservatives, and in the production of paper, textiles, cosmetics, disinfectants, medicines, paints, varnishes and lubricants.

## Why the Concern Over Formaldehyde ?

The International Agency for Research on Cancer (IARC) a division of the World Health Organization has recently reclassified formaldehyde from a group 2A suspected carcinogen to a known carcinogen.

It must be stressed that the cancer causing properties of formaldehyde are only evident at **very high** concentrations, hundreds of times greater than levels emitted from plywood and laminated veneer lumber products.

The IARC has established that at concentrations of less than 0.1ppm formaldehyde is undetectable by smell. At concentrations from 0.1ppm to 0.5ppm, formaldehyde is detectable by smell with some sensitive individuals experiencing slight irritation to the eyes, nose and throat. At levels from 0.5 to 1.0ppm, formaldehyde will produce irritation to the eyes, nose and throat of most people. At concentrations above 1.0ppm exposure to formaldehyde will produce extreme discomfort.

## What is the safe level of Formaldehyde Exposure ?

Worksafe Australia has established 1.0ppm TWA (time weighted average) over an eight hour period with a 2ppm STEL (short term exposure limit) of 15 minutes as the safe level for occupational exposure. New Zealand has an OEL (Occupational Exposure Limit) of 1.0ppm that cannot be exceeded at any time.

There are currently no legislative requirements for indoor air quality under which formaldehyde emissions from products are regulated in Australia or New Zealand. However, indoor air quality is a topic for consideration in future updates to the Building Code of Australia.

A number of countries have adopted regulations for indoor air quality. The US Department of Housing and Urban Development has specified limitations for formaldehyde emitting products with underlayment and decking materials limited to emissions of 0.2ppm and panelling and other products limited to 0.3ppm. The Europeans have adopted the E<sub>1</sub> regulation, which limits formaldehyde emissions from products to a level that produces a maximum indoor air concentration of 0.1ppm.

The Japanese currently have the most stringent regulations under their "Sick House Legislation". For indoor environments products must meet the F☆☆☆☆ classification, which restricts emissions to 0.03ppm. This is equivalent to background levels and is effectively a zero emission limit.

Internationally, the generally accepted emission limit is 0.1ppm.

## Why is there Particular Concern with Wood Based Panels?

Reconstituted wood based panels such as particleboard and medium density fibreboard (MDF) many years ago were a major source of formaldehyde emissions in domestic dwellings. Over the past 20 years emissions from these products have been reduced by approximately 90% with emissions from Australian made products now very low.

Plywood and laminated veneer products on the other hand are manufactured from glued wood veneers which use only a small fraction of the adhesive of an equivalent particleboard or MDF product. Plywood and LVL have not generally been associated with high formaldehyde emission levels.

## What are the Formaldehyde Emissions From PAA Certified Products ?

The Engineered Wood Products Association of Australasia has for a number of years been monitoring formaldehyde emissions from its members' products through testing conducted at their NATA National Testing Laboratory to the most stringent Japanese regulations and for compliance with Australian Standards.

Plywood and LVL products are manufactured using two basic adhesive types phenol formaldehyde (PF) and amino plastic, which includes melamine urea formaldehyde (MUF) and urea formaldehyde (UF).

The chemistry of these two adhesive types is vastly different. Phenol formaldehyde adhesives consume free formaldehyde during the polymerisation and curing processes, the chemical reaction being irreversible. PF bonded products do not emit formaldehyde after any low level residual formaldehyde from the manufacturing process has dissipated within a few days of manufacture.

Phenol formaldehyde adhesive which can be identified through its black colour is called Type A under the Australian and New Zealand plywood and LVL standards as is used in the manufacture of structural plywood, marine plywood, exterior (Type A) and structural LVL products.

In both the US and Europe, products bonded with phenol formaldehyde adhesives are classified as non-emitting and are exempt from formaldehyde emission regulations.

Amino plastic bonded products tend to have higher residual free formaldehyde levels and can emit low levels of formaldehyde.

Approximately 90% of all EWPAA members' production from Australia, New Zealand, Fiji and Papua New Guinea are manufactured using the non-emitting phenol formaldehyde adhesives.

## Emissions from Phenol Formaldehyde Bonded Products

On-going tests on products from all EWPAA certified producers on newly manufactured (within 48 hours of manufacture) plywood and laminated veneer lumber, showed the average emission from all phenol formaldehyde bonded products to be only 0.006ppm. At this extremely low level of emission approximately 50% of the formaldehyde measured has been emitted naturally by the wood itself. This emission level is 5 times less than the naturally occurring background concentration of 0.03ppm and well below the most stringent Japanese regulation of 0.03ppm.

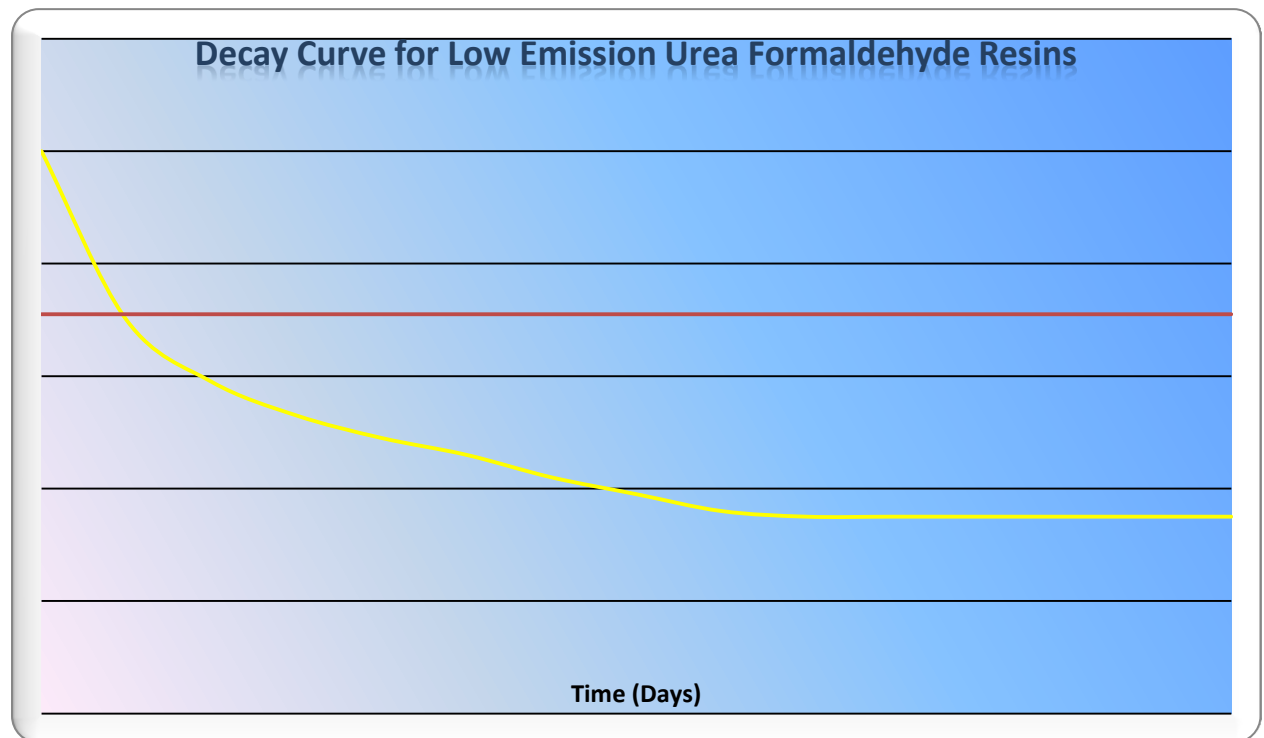
It must be noted that testing is conducted on freshly manufactured product when emissions are at their highest. Testing of aged phenolic bonded products has shown emissions reduce to zero within a short time.

## Emissions from Amino Plastic Bonded Products

Emissions from amino plastic bonded products manufactured using standard resins has shown that products tested meet the European E<sub>1</sub> emission rate of 5 mg/m<sup>2</sup>/hr for newly manufactured material (within 72 hours of manufacture). This emission rate will equate to an indoor air formaldehyde concentration of less than 0.1ppm.

Importantly, products manufactured using recently developed low formaldehyde emitting adhesives have shown significantly lower emissions, as low as 0.002ppm.

Figure One details results of further testing showing the decay curve for formaldehyde emissions from urea formaldehyde bonded products over time. These results show that emissions are at their maximum just after manufacture and reduce by 65% within a few months. It should also be noted, with modern low emitting adhesives, emissions dropped to below background levels approximately one week after manufacture.



**Source: Decay curve : Orica Adhesives, Back ground level : testing undertaken at Plywood House, Brisbane Australia, February 2004 (0.009 ppm)**

## What about Occupational Exposure ?

On-going testing in plywood and laminated veneer lumber mills in Australia and New Zealand has shown formaldehyde levels to be generally quite low and well below the 1 ppm 8hr TWA required by Worksafe Australia.

## What is being done to reduce Formaldehyde Emissions Further ?

EWPA member mills share the public's concern over excessive formaldehyde in the built environment. To this end the EWPA and its members continue to strive to produce products with ever-reduced formaldehyde emissions. Specific on-going action has included:

- A continual move away, where possible, from amino plastic adhesives to non-emitting phenol formaldehyde based adhesives.
- The EWPA and its members continue to work closely with resin suppliers to produce and commercialise adhesive systems with much lower formaldehyde emissions.
- Effort is being taken to continually reduce workplace and occupational exposure.
- Australian/New Zealand Plywood and LVL Product Standards have now been updated to include a mandatory requirement to label the formaldehyde emission class.

The formaldehyde emission classes in the Australian/New Zealand Standards are detailed in Table One. Products labelled with emission classes E<sub>0</sub> and E<sub>1</sub>, have extremely low formaldehyde emissions.

<b>Emission Class</b>	<b>Formaldehyde Emission Limit (mg/l)</b>	<b>Formaldehyde Emission Limit (ppm)*</b>
Super E <sub>0</sub>	Less than or equal to 0.3	Less than or equal to 0.024
E <sub>0</sub>	Less than or equal to 0.5	Less than or equal to 0.04
E <sub>1</sub>	Less than or equal to 1.0	Less than or equal to 0.08
E <sub>2</sub>	Less than or equal to 2.0	Less than or equal to 0.16
E <sub>3</sub>	Greater than 2.0	Greater than 0.16

\* Based on a test chamber volume of 10litre, zero airflow during the 24hr test cycle, molecular weight of formaldehyde 30.03 and the number of microlitres of formaldehyde gas in 1 micromole at 101KPa and 298K.

**Table 1 : Formaldehyde Emission Classes from Australian / New Zealand Standards**

## Conclusion

Formaldehyde emissions from EWPA certified products are well below acceptable exposure limits specified by Workplace Australia and do not constitute a health risk. Emissions from phenol formaldehyde bonded products representing approximately 90% of all Australian, New Zealand, Fijian and Papua New Guinean production are effectively zero.

The EWPA will continue to assist resin suppliers and its members to develop lower emitting products with the aim of providing veneer based wood products meeting the most stringent international regulations.

Simon Dorries  
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**GENERAL MANAGER**

## References and Further Reading

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- (13) US Environmental Protection Agency, “Sources of Indoor Pollution – Formaldehyde (March 2004)”
- (14) Wood Panels Industries Federation, “Formaldehyde and Wood-based Panels”



## Revision History

Revision	Changes	Date	Who
4	<ul style="list-style-type: none"><li>Added Super E0 to Table of Formaldehyde Emissions Classes</li></ul>	18-02-15	AM
3	<ul style="list-style-type: none"><li>Changed to standard Technical Note format.</li><li>Updated logos and member list.</li></ul>	07-02-12	MB
2	<ul style="list-style-type: none"><li>General Formatting update.</li><li>Changed references from PAA to EWPA</li><li>Added mandatory labeling in AS and NZS product standards</li><li>Add, changed and removed some hyperlinks in the references section</li></ul>	28-02-2008	SD
1	Initial Release	16-07-2004	SD

**PRODUCT CERTIFIED**



**JAS-ANZ**



[www.jas-anz.org/register](http://www.jas-anz.org/register)

## EWPAA Members

Plywood and Laminated Veneer Lumber (LVL)				
Member Name	Location	Phone	Fax	Web
Ausply	NSW	+61 2 6926 7300	+61 2 6922 7824	<a href="http://www.ausply.com">www.ausply.com</a>
Austral Plywoods Pty Ltd	QLD	+61 7 3426 8600	+61 7 3848 0646	<a href="http://www.australply.com.au">www.australply.com.au</a>
Big River Group Pty Ltd	NSW	+61 2 6644 0900	+61 2 6643 3328	<a href="http://www.bigrivergroup.com.au">www.bigrivergroup.com.au</a>
Carter Holt Harvey Woodproducts Australia (Plywood) – Myrtleford	Vic	+61 3 5751 9201	+61 3 5751 9296	<a href="http://www.chhwoodproducts.com.au">www.chhwoodproducts.com.au</a>
Carter Holt Harvey Woodproducts Australia – Nangwarry LVL	SA	+61 8 8739 7011		<a href="http://www.chhwoodproducts.com.au">www.chhwoodproducts.com.au</a>
Carter Holt Harvey Woodproducts - Marsden Point LVL	NZ	+64 9 432 8800	+64 9 432 8830	<a href="http://www.chhfuturebuild.co.nz">www.chhfuturebuild.co.nz</a>
Carter Holt Harvey Woodproducts (Plywood) - Tokoroa	NZ	+64 7 885 5999	+64 7 885 5614	<a href="http://www.chhwoodproducts.co.nz">www.chhwoodproducts.co.nz</a>
Fiji Forest Industries	FIJI	+67 9 881 1088	+67 9 881 3088	
IPL (West Coast) Ltd	NZ	+64 3 762 6759	+64 3 762 6789	
Juken New Zealand Ltd (Gisborne)	NZ	+64 6 869 1100	+64 6 869 1130	<a href="http://www.jnl.co.nz">www.jnl.co.nz</a>
Juken New Zealand Ltd (Wairarapa)	NZ	+64 6 370 0650	+64 6 370 0653	<a href="http://www.jnl.co.nz">www.jnl.co.nz</a>
Nelson Pine Industries Ltd	NZ	+64 3 543 8800	+64 3 543 8890	<a href="http://www.nelsonpine.co.nz">www.nelsonpine.co.nz</a>
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RH (PNG) Ltd	PNG	+67 5 325 5600	+67 5 325 6165	<a href="http://www.rhpng.com.pg">www.rhpng.com.pg</a>
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Particleboard and MDF				
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Borg Panels Pty Ltd	NSW	+61 2 6339 6111	+61 2 6339 6220	<a href="http://www.borgs.com.au">www.borgs.com.au</a>
Carter Holt Harvey Woodproducts Australia	NSW	1800 891 881	+61 2 9468 5793	<a href="http://www.chhwoodproducts.com.au">www.chhwoodproducts.com.au</a>
D & R Henderson Pty Ltd	NSW	+61 2 4577 4033	+61 2 4577 4759	<a href="http://www.drhenderson.com.au">www.drhenderson.com.au</a>
Laminex	VIC	+61 3 9848 4811		<a href="http://www.thelaminexgroup.com.au">www.thelaminexgroup.com.au</a>
Tasmanian Wood Panels (Aust)	TAS	+61 3 9460 7766	+61 3 9460 7268	
Weatherex Pty Ltd	NSW	1800 040 080		<a href="http://www.weatherex.com.au">www.weatherex.com.au</a>



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