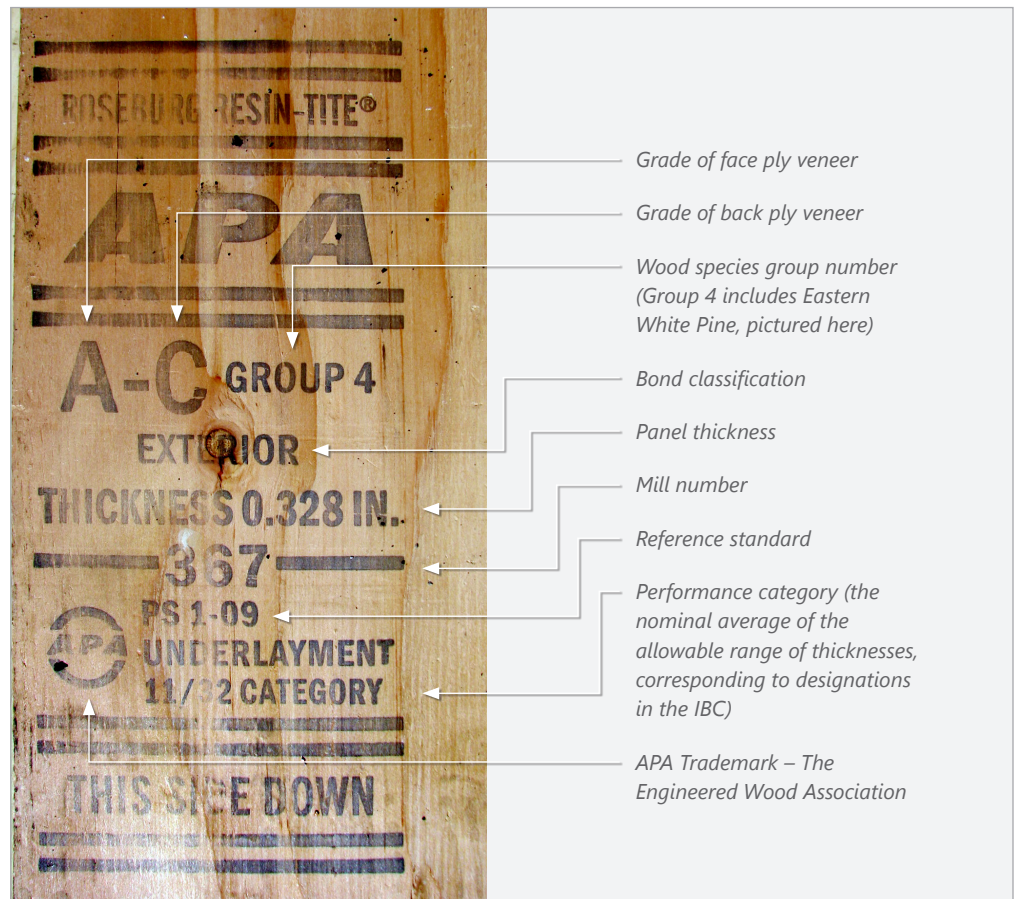


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**A closer look at plywood's bond classification.**

## Exterior or Exposure 1 Plywood What's the Difference?

Plywood is not as straightforward a subject as you might think. There are numerous variables that distinguish one piece of plywood from another—wood species, veneer grade, bond classification, etc. Any one of these variables could be the topic of an entire primer. In this issue, we will be focusing on bond classification. To start with, let's look at a typical APA grade stamp to familiarize ourselves with the lingo.



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## Plywood (CONTINUED)

APA trademarked panels have one of two bond classifications: Exterior or Exposure 1 (commonly called "CDX").<sup>1</sup> Bond classification relates to veneer grade and performance of the adhesive bonding the plies together. Veneer grades are designated A through D, depending on the quantity and size of knots, borer holes, and other flaws. A is the clearest grade with the fewest flaws and grade D contains the most defects. The plies in an Exterior plywood panel must be grade C or better. This includes the inner plies as well as the face and back plies. Exposure 1 plywood is permitted to contain D grade veneers. In addition, more stringent limits are placed on Exterior plywood for filling of small cracks, checks, splits, chips, and other defects in the veneers.

The adhesive difference between the classifications is a bit more complicated. Both Exterior and Exposure 1 plywood are fabricated with waterproof glue, but this does not mean the glue is identical in every plywood panel. The most common type of adhesive is phenolformaldehyde, but other types of adhesives can be used, and the adhesive formulas can vary greatly due to a wide variety of additives (resorcinol,

melamine, urea, etc.). The adhesive type along with veneer species, surface quality and moisture content of the veneers, penetration of the adhesive into the veneer, and many other environmental and manufacturing factors can influence the performance of the adhesive bond. There are two tests that play a role in determining Exterior versus Exposure 1 bond classification: vacuum-pressure and boiling tests. The vacuum-pressure test requires samples to be submerged in water in a vacuum for thirty minutes, then immediately exposed to pressure for thirty minutes. The boiling test involves boiling the samples for four hours, allowing them to dry, and boiling them again for four hours. Following both tests, the samples are subjected to tension loading (perpendicular to the plies) while wet until failure occurs. The amount of wood fiber remaining at the bond line is examined and expressed as a percentage of the sample size. These percentages are referred to as "wood failure." Exterior plywood must demonstrate better wood failure percentages than Exposure 1 plywood, indicating a stronger adhesive bond between the plies.<sup>2</sup>

So, what does all of this mean for roofing applications? Per APA's definitions, "Exterior plywood is suitable for repeated wetting and redrying or long-term exposure to weather..." and "Exposure 1 plywood is suitable for uses not permanently exposed to the weather."<sup>3</sup> APA further states that "aesthetic attributes of the [Exposure 1] panels may be compromised to some degree by exposure to the weather...Panel surfaces may become uneven and irregular under prolonged moisture exposure."<sup>4</sup> In theory, roof sheathing should not be exposed to the weather. In reality, however, most roofs suffer from some problems over time. Even small deficiencies, like a broken shingle, exposed or popped nails, or pin holes in flashings, can potentially allow water to reach the sheathing and result in deterioration. Exterior plywood is better able to withstand exposure to moisture and is therefore more likely to achieve a longer service life without warping or delaminating. Exterior plywood is more costly than Exposure 1, but the greater durability is often worth it, especially with long-lived roofing materials such as slate, tile, and copper.

<sup>1</sup> Interior plywood is not certified by APA.

<sup>2</sup> More information about testing procedures and wood failure requirements for each bond classification can be found in *Voluntary Product Standard PS 1-09 Structural Plywood*, available at <http://gsi.nist.gov/global/docs/vps/PS-1-09.pdf>.

<sup>3</sup> National Institute of Standards and Technology. *Voluntary Product Standard PS 1-09 Structural Plywood*. US Dept. of Commerce, 2010. <http://gsi.nist.gov/global/docs/vps/PS-1-09.pdf>.

<sup>4</sup>"Bond Classification." *APA Technical Topics*. January 2008. [www.clp-inc.com/app/download/6768262404/TT-009.pdf](http://www.clp-inc.com/app/download/6768262404/TT-009.pdf).

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