PRESERVATIVE TREATED WOOD

UNDERSTANDING THE ISSUES

Metal connectors, anchors, and fasteners will corrode and may lose load carrying capacity when installed in corrosive environments or exposed to corrosive materials. There are many environments and materials which may cause corrosion including:

- Ocean salt air
- Fire-retardants
- Preservative-treated wood
- Dissimilar metals
- Fertilizers
- Fumes

The many variables present in a single building environment make it impossible to accurately predict if, or when, significant corrosion will begin or reach a critical level. This relative uncertainty makes it crucial that specifiers and users be knowledgeable of the potential risks and select a product coating or metal suitable for the intended use. It is also important that regular maintenance and periodic inspections are performed, especially for outdoor applications.

It is common to see some corrosion on connectors, fasteners, and anchors especially in outdoor applications. Even Stainless Steel can corrode. The presence of some corrosion does not mean that load capacity has necessarily been affected or that a failure will occur. If significant corrosion is apparent or suspected, then the wood, fasteners, anchors, and connectors should be inspected by a professional engineer or general contractor and may need to be replaced.

Changes in the preservative-treated wood industry have created additional concerns. Effective December 31, 2003, the preservative-treated wood industry voluntarily transitioned from Chromated Copper Arsenate (CCA-C) used in residential applications to alternative treatments. Testing has shown that certain alternative replacement treatments are generally more corrosive than CCA-C.

Due to the many different pressure treatment formulations, fluctuating retention levels, and because the formulations may vary regionally or change without warning, understanding which connectors, fasteners, and anchors to use with these materials has become a complex task. We have attempted to provide basic knowledge on the subject here, but it is important to fully educate yourself by reviewing our technical bulletins on the topic, and also by viewing information and literature provided by others. Additionally, because the issue is evolving, it is important to get the very latest connector information on the topic by visiting our website **www.strongtie.com/info**.

The treated wood industry has recommended the use of Stainless Steel or hot-dip galvanized fasteners and connectors for years. This recommendation is still the same for use with the alternative treatments but additional clarification is needed to insure that adequate corrosion protection is provided. Specifying hot-dipped galvanized products is often very generic, as steel products can be considered hot-dip galvanized while having various thickness levels. Failure to be specific regarding the amount of hot-dip galvanizing protection can lead to use of products which may not be sufficient for the intended use.

There are two primary processes used to hot-dip galvanize (HDG) products –"continuous" hot-dip galvanizing and "batch" or "post" hot-dip galvanizing. Continuous hot-dip galvanizing is a process completed at the steel manufacturing facility where a continuous sheet of light gauge steel is "dipped" into a zinc bath and a protective HDG coating is applied to a specified thickness. The steel is then shipped as a coil and used to manufacture many of the products produced by Simpson Strong-Tie. (The required minimum levels of galvanizing provided by this process are covered by ASTM A653.) Batch or "post" hot-dip galvanizing is generally used on heavier individual products not capable of being fabricated from galvanized steel coils and can also be used to galvanize some fasteners and anchors. Products are fabricated then shipped out to be "dipped" into a molten zinc bath to provide protection against corrosion. (The required minimum levels of galvanizing provided by this process are covered by ASTM A123 for individual connectors and by ASTM A153 for fasteners.)

The corrosion performance of a hot-dip galvanized product is a function of the amount of zinc on its surface. Simply put, more zinc means better performance. Historically the connector industry has used products manufactured with a G60 coating which means 0.60 oz/ft^2 of zinc was continuously applied to the steel coil. In recent years, Simpson made the decision to increase the minimum standard amount of zinc protection to a G90 coating, 0.90 oz/ft^2. This represents a 50 percent increase in protection versus the industry standard and is the minimum level of galvanizing provided on all Simpson galvanized products. Simpson also offers many products with ZMAX™ which is a G185 coating, 1.85 oz/ft^2.

Testing has shown that type 304 and 316 Stainless Steel products corrode substantially less than other alternatives when used with the alternative wood treatments. Simpson has a number of Stainless Steel products available and recommends the use of Stainless Steel as the most effective solution to corrosion risk. However, it is also more expensive and sometimes more difficult to obtain.

Simpson testing has shown that relative corrosion based on quantitative measurements, visual observation, and calculations indicate the alternative wood preservatives tested are generally more corrosive than CCA-C. The number of variables that affect the rate of corrosion make it impossible to apply these test results to all product combinations, installations, and environmental conditions. These results cannot be correlated to service life.

Because increased corrosion from some pressure-treated woods is a new issue with little historical data, we have to base our recommendations on the testing and experience we have to date. It is possible that as we learn more, our recommendations may change, but these recommendations are based on the best information we have at this time.

SIMPSON Strong-Tie™

The following information is a summary of the testing and analysis that Simpson Strong-Tie has performed related to the Pressure-Treated Wood industry's voluntary transition away from the use of CCA-C treated wood for residential and general consumer use. The information is intended to help aid in selection of coatings provided on connectors, fasteners, and anchors that are in contact with preservative-treated wood.

We continue to research this evolving topic. Stay informed by visiting **www.strongtie.com/info** for the very latest information.

800-999-5099
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SCOPE OF TESTING

Due to the wide variety of steel and fastener coatings available and the number of possibilities of pressure treatment chemicals which may be used, Simpson Strong-Tie has conducted a series of tests to assess the relative corrosive impact of various pressure-treated woods on connectors, fasteners and anchors. These independently witnessed tests were performed in compliance with the American Wood-Preservers' Association Standard E12-94 "Standard Method of Determining Corrosion of Metal in Contact With Treated Wood."

Testing was performed by Simpson Strong-Tie on over 1,800 steel coupons per the E12-94 test procedure summarized as follows:

- 1"x2" steel coupon samples were prepared by thoroughly cleaning and weighing each sample.
- The samples were then sandwiched between two 1½"x3"x ¾" pressure treated wood blocks.
- A ¼" diameter nylon bolt was used on each end to clamp the samples together to provide uniform contact on the coupon.
- Samples were then placed in an environmental chamber held at 120°F and 90% humidity.
- The samples were removed from the chamber, cleaned and weighed.
- The standard provides an equation which was then used to determine the corrosion rate in mils per year. The corrosion rate was used for comparison purposes only and does not correlate to any life expectancy.

Fastener tests were also performed on over 3,000 samples using a procedure similar to the E12-94 summarized as follows:

- The fasteners were thoroughly cleaned and weighed.
- Six fasteners were installed into the narrow face of a 2x4 pressure-treated wood block 6" to 9" long.
- Each block was placed in the environmental chamber.
- Fasteners were removed from the wood block using a chisel instead of withdrawing the fasteners from the wood.
- Fasteners were cleaned, weighed, and calculations were performed to determine the percentage weight loss as an average of the six fasteners.

The following tables indicate some of the items examined in the testing. Note that there are test results on all of these items; however, this bulletin only reviews the performance of hot-dip galvanizing with the treated woods.

Wood Treatment
CCA-C
Copper Azole (CBA-A, CA-B)
ACQ-C, ACQ-D (Carbonate)
Sodium Borate (SBX/DOT)
Zinc Borate
ACZA[1]
Untreated
Borate (Other)

Fasteners
N8, N10, 10d, 16d
Various other nails
SDS, Lag screws, & Bolts
SD8's
WA's, THD's, PDP's
ATR
Misc. Others

Metal Coatings
Uncoated
G90
ZMAX™
Batch HDG
304 & 316 SS
SST Grey Paint
Misc. Others

Fastener Coatings
HDG
EP, Zinc Dich.
Uncoated
Mech. Galv.
Misc. Others

[1] With the exception of ACZA, treatments with ammonia carriers were not included in this testing.

Additional testing was performed using barrier membranes. See T-PTBARRIER05 for additional information.

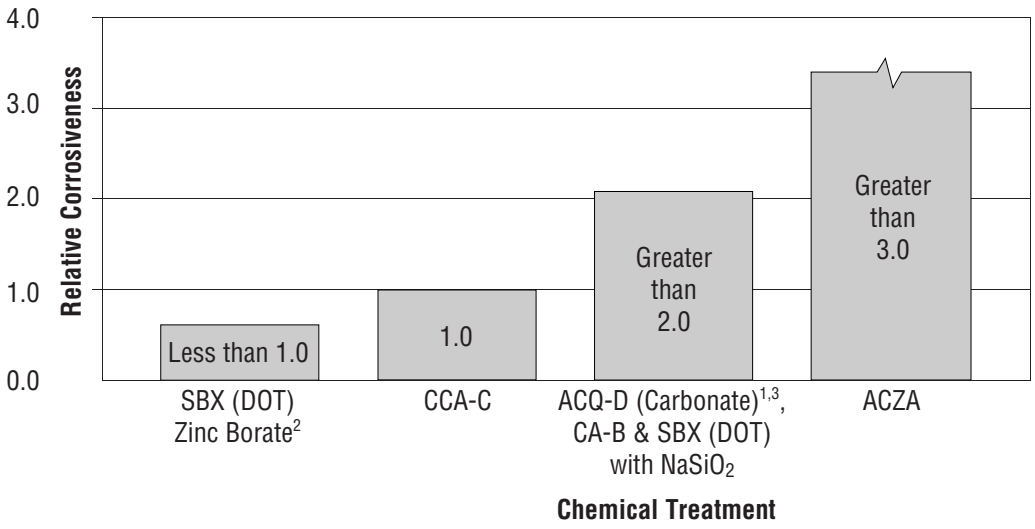
TEST RESULTS

A detailed analysis was performed on the data accumulated from the steel coupon and fastener samples. The following figure represents a general summary of some of the test results.

It is important to note that even within a specific treatment chemical (CCA-C, ACQ-D (Carbonate), CA-B, etc.) there can be a number of variations in the formulation which can affect the results. These variations are controlled by the chemical supplier and the wood treater so care must be exercised when specifying the treated wood to be used. Formulations may be modified in attempts to provide better performance in penetrating the wood, improving water repellancy, providing short term improvements in corrosion performance, etc. It is possible that a slight modification in the formulation of a treatment can have an effect on the corrosion potential.

Figure 1 compares the average tested relative corrosiveness of several treatments to the corrosion which occurred with CCA-C treated wood. The numbers shown are an average of the results of G90 and G185 continuous hot-dipped galvanized steel samples. Test results shown are based on accelerated testing per AWPA Standard E12-94, and may or may not have a relation to actual service life.

Figure 1



Notes:

1. The relative corrosion rates of ACQ-D (Carbonate) and CA-B treated wood on hot-dip galvanized steel were grouped and analyzed together.
2. Zinc Borate is a preservative treatment for wood composites.
3. All testing was performed on woods with retention levels at Ground Contact - or below (0.40 pcf for ACQ; 0.21 pcf for CA-B)

From this figure the following observations are made:

- ACQ-D (Carbonate), CA-B, and SBX (DOT) with $NaSiO_2$ treated wood is on the average approximately two times more corrosive than CCA-C treated wood. Note that the standard galvanized coating for years on Simpson connectors was G60 which has proven over time to perform well on CCA-C wood. Thus, it could be reasoned that there needs to be at least two times the coating protection when used in conjunction with the tested ACQ-D (Carbonate), CA-B, and SBX (DOT) with $NaSI0_2$ treatments. Thus, it is Simpson's recommendation that at a minimum a ZMAX™ coating, which provides approximately 3 times the corrosion protection of G60, should be applied to meet the potential demand from these treated woods. See Recommendation Chart for more detail.
- Testing on Sodium Borate (DOT-Disodium Octaborate Tetrahydrate) treated wood generally indicates corrosion rates less than seen with CCA-C treated wood.

PRESERVATIVE TREATED WOOD

GENERAL SIMPSON RECOMMENDATIONS

- Outdoor environments are generally more corrosive to steel. If you choose to use ZMAX or HDG on an outdoor project (i.e. deck, patio cover), you should periodically inspect your connectors and fasteners or have a professional inspection performed. Regular maintenance including water-proofing of the wood used in your outdoor project is also a good practice.
- For wood with actual retention levels greater than 0.40 pcf for ACQ, 0.41 pcf for CBA-A, or 0.21 pcf for CA-B (Ground Contact), Stainless Steel connectors and fasteners are recommended. Verify actual retention level with the wood treater.
- When using Stainless Steel connectors, use Stainless Steel fasteners. When using ZMAX/HDG galvanized connectors, use fasteners galvanized per ASTM A153.
- Testing indicates wood installed dry reduces potential corrosion. If dry wood is used, see our website for additional information.
- With the exception of ACZA, treatments with ammonia carriers were not included in this testing. Preservatives with an ammonia base (carrier) are generally known to be more corrosive.
- Contact Simpson for availability of ZMAX™, Post Hot-Dip Galvanized, and Stainless Steel products.

Due to the many variables involved, Simpson cannot provide estimates on service life of connectors, anchors or fasteners. We suggest that all users and specifiers also obtain recommendations for ZMAX™ (G185 per ASTM A653) Hot Dip Galvanized (per ASTM A123 for connectors and ASTM A153 for fasteners and anchors) or mechanically galvanized fasteners and anchors (per ASTM B695 class 55 or greater) or other coatings from the treated wood supplier for the type of wood used. However, as long as Simpson's recommendations are followed, Simpson stands behind its product performance and our standard warranty applies.

GUIDELINES FOR SELECTING THE PROPER CONNECTOR

1 Evaluate the Application.
Consider the type of structure and how it will be used.
These recommendations may not apply to non-structural applications such as fences.

2 Evaluate the Environment

Testing and experience indicate that indoor dry environments are less corrosive than outdoor environments. Determining the type of environment where a connector or fastener will be used is an important factor in selecting the most appropriate material and finish for use on the connectors and fasteners. To help in your decision making, consider the following general exposure information:

Interior Dry Use: Includes wall and ceiling cavities, and raised floor applications of enclosed buildings that have been designed to ensure that condensation and other sources of moisture do not develop.

Exterior - Dry: Includes outdoor installations in low rainfall environments and no regular exposure to moisture.

Exterior - Wet: Includes outdoor installations in higher moisture and rainfall environments.

Higher Exposure Use: Includes exposure to ocean salt air, large bodies of water, fumes, fertilizers, soil, some preservative treated woods, industrial zones, acid rain, and other corrosive elements.

3 Evaluate and select a suitable pressure-treated wood for the intended application and environment.

The treated wood supplier should provide all the information needed regarding the wood being used. This information should include: the specific type of wood treatment used, if ammonia was used in the treatment, and the chemical retention level.
If the needed information is not provided then Simpson would recommend the use of Stainless Steel connectors and fasteners. You should also ask the treated wood supplier for a connector coating or material recommendation.

4 Use the chart on the right, which was created based on Simpson's testing and experience to select the connector finish or material.

If a pressure treated wood product is not identified on the chart, Simpson has not evaluated test results regarding such product and therefore cannot make any recommendation other than the use of Stainless Steel with that product. Manufacturers may independently provide test results or other product use information; Simpson expresses no opinion regarding any such information.

5 Compare the treated wood supplier's recommendation with the Simpson recommendation.

If these recommendations are different, Simpson recommends that the most conservative recommendation be followed.

Low = Use Simpson standard painted and G90 galvanized connectors as a minimum.
Med = Use ZMAX/HDG galvanized connectors as a minimum. Use fasteners galvanized per ASTM A153.
High = Use Type 304 or 316 Stainless Steel connectors and fasteners.

Connector Coating Recommendation - Structural Applications

Environment	Untreated Wood	SBX/DOT & Zinc Borate	ACQ-C, ACQ-D (Carbonate), CA-B & CBA-A			ACZA	Other or Uncertain
			No Ammonia	With Ammonia	Higher Chemical Content[1]		
Interior Dry	Low	Low	Med	Med	High	High	High
Exterior - Dry	Low	N/A[2]	Med	High	High	High	High
Exterior - Wet	Med	N/A[2]	Med[3,4]	High	High	High	High
Higher Exposure	High	N/A[2]	High	High	High	High	High
Uncertain	High	N/A[2]	High	High	High	High	High

1. Woods with actual retention levels greater than 0.40 pcf for ACQ, 0.41 pcf for CBA-A, or 0.21 pcf for CA-B (Ground Contact level).
2. Borate treated woods are not appropriate for outdoor use.
3. Test results indicate that ZMAX/HDG will perform adequately, subject to regular maintenance and periodic inspection. However, the nationally-approved test method used, AWPA E12-94, is an accelerated test, so data over an extended period of time is not available. If uncertain, use Stainless Steel.
4. Some treated wood may have excess surface chemicals making it potentially more corrosive. If you suspect this or are uncertain, use Stainless Steel.

This bulletin is effective until January 31, 2006, and reflects information available as of January 1, 2005. This information is updated periodically and should not be relied upon after January 31, 2006; contact Simpson for current information and limited warranty or see www.strongtie.com.

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Printed in the USA

T-PTWOOD05 1/05 exp. 1/06