ARCH Technical Note

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Corrosion and Hardware Recommendations for Treated Wood

What affects the choice of hardware for treated wood?

Maintaining the structural integrity of the fastener or connector for the intended service life is in most cases the primary consideration when choosing hardware. The most common factors affecting the durability of hardware used in contact with treated wood are:

- The exposure conditions (moisture, temperature, and air-borne contaminants)
- The type and retention of treatment used
- Storage and processing after treatment
- The materials comprising the hardware

Aesthetic design considerations or special safety or durability requirements may also be important.

What is corrosion?

Corrosion is a chemical reaction. The primary type of corrosion that occurs with metal hardware on treated wood is dissimilar metal or galvanic corrosion. This type of corrosion occurs whenever different types of metals come in contact in a wet environment. The potential for corrosion of hardware on treated wood occurs when metals in the treatment (such as copper) are different from the metals in the hardware (the iron in steel or aluminum). The dissimilar metals then create a small electrical current, just as a battery does. One of the metals becomes the anode and corrodes faster than it would alone, while the other becomes the cathode and corrodes slower than it would alone. The rate of galvanic corrosion depends on the difference in the electrical potential of the metals, the moisture content (and resultant conductivity) of the wood, and the temperature.

What is the impact of the exposure conditions?

Applications such as fresh water or ground contact result in continuously elevated wood moisture content and provide an environment for ongoing corrosion. In above-ground applications such as decking, cyclic wetting and drying will occur. During dry periods when the wood moisture content is under 15 to 17%, the wood is not significantly conductive to electricity and galvanic corrosion will essentially cease. Corrosion also proceeds much more rapidly when temperature is elevated, perhaps from warm climates or in applications such as roof systems or hot industrial processes. Like all chemical reactions, the corrosion rate can be expected to roughly double for every 20° F increase in temperature. Special consideration needs to be given to air-borne contaminants such as salt near oceans or situations where acids, salts or other chemicals may have much greater impact on fastener corrosion than the wood treatment.

What type and retention of treatment was used?

The particular combination of treatment and metal hardware can have a major impact on the corrosion. CCA treated wood in outdoor applications has been successfully used for more than 30 years with hot dipped galvanized steel fasteners. However, CCA treated wood in damp environments has never been recommended for use with aluminum. Borates, while showing similar corrosion to CCA on unprotected mild steel, have often been shown to be less corrosive to galvanized steel hardware. Copper based preservatives now used in place of CCA, with higher levels of copper, show a slight increase in the corrosion rates on mild steel. The retention level of a treatment can also affect the corrosion rate. When wood is treated for above ground applications, it

contains the lowest levels of preservative; when wood is treated for ground contact or structural applications retentions are higher and corrosion rates may be higher, especially if the wood has not been dried after treatment.

What was the after treatment processing?

After treatment processing may include extended storage or kiln drying. These provide an opportunity for copper to react more fully with the wood, which lowers the potential for corrosion. Drying also reduces the wood moisture content.

What influence does the type of hardware have?

Most hardware is made of mild steel. In applications where corrosion may occur, steel is often protected with zinc (galvanized) or proprietary coatings. Zinc coatings react in environments that are cyclically wet and dry to form zinc compounds that are stable, preventing further corrosion. Proprietary coatings are intended to form a non-reactive barrier that prevents moisture from reaching the base steel. Non-ferrous metal hardware is used in specialty applications. Copper, copper alloys and stainless steel are generally more resistant to corrosion than mild steel.

Building code fastener requirements

The International Residential Code (§R319.3) and the International Building Code (§2304.9.5) have similar requirements for fasteners used with treated wood. Both codes require fasteners to be hot-dipped galvanized steel meeting ASTM A153. The Residential Code has an exception that permits non-galvanized ½" and larger anchor bolts. There is also a pending change to permit mechanically galvanized fasteners meeting ASTM B695, Class 55 in both of these codes. Current provisions for fasteners in the code do not discriminate between types of preservatives, the severity of the end use environment or have provisions for either connectors or flashing.

Fastener, connector and flashing recommendations

Fasteners should be of the same type metal as any connectors or flashing that they are used to secure or in contact with. Having two different types of metals in contact or very close proximity will result in galvanic corrosion and may cause premature failure of the fastener, connector or flashing.

Zinc or cadmium electroplated fasteners have minimal protection and are not suitable for use in corrosion prone environments. They are not recommended for use except in dry applications where the use of non-galvanized steel is permitted. Hot-dipped galvanized connectors should be inspected to insure that the galvanizing is continuous, of an even appearance, and free from debris.

In severe environments having an unusually high corrosion hazard such as those that are continuously wet or within 5 miles of salt water, in critical architectural applications where appearance is of great importance, and in structural applications of an especially critical nature or where an exceptionally long service life is required, the use of hardware having corrosion durability equivalent to or greater than 304 or 316 stainless steel should be used.

The following recommendations are based on the experience of Arch Wood Protection, Inc. and Arch Treatment Technologies, Inc. and testing of products by these companies. They are general recommendations and may not be suitable for every application. Consideration must always be given to any special conditions, local environments or critical applications.

Important Note: *In code applications, the choice of fasteners should always take into consideration the acceptability of the fastener to the local building inspector or other authority having jurisdiction. The use of mild steel, electroplated galvanized or galvanized steel fasteners that do not comply with ASTM A153 or A695 is not recognized by most building codes for use with treated wood.*

Copper Azole and CCA Treated Wood (1)

	Indoors Always Dry (<15% MC)	Protected From Weather Dampness OK	Outdoor In Weather Regular Wetting	Coastal Applications	Wood Foundation & Other Critical Applications
AWPA Use Category	**UC 1**	**UC 2**	**UC 3, UC 4A**	**UC 3, 4, 5**	**UC 4B**
Fasteners	Mild Steel, EP (2) HDG HDG per ASTM A153 MG per ASTM A695 Class 55 Copper 304/316 SS	HDG per ASTM A153 MG per ASTM A695 Class 55 Copper 304/316 SS	HDG per ASTM A153 MG per ASTM A695 Class 55 Copper 304/316 SS	304/316 SS	304/316 SS
Connectors – Light gauge steel	HDG (3) HDG - ASTM A653 Class G185 Copper 304/316 SS	HDG - ASTM A653 Class G185 304/316 SS	HDG - ASTM A653 Class G185 304/316 SS	304/316 SS	NA
Connecters – Heavy duty welded steel	HDG – ASTM A123 304/316 SS	HDG – ASTM A123 304/316 SS	HDG – ASTM A123 304/316 SS	304/316 SS	NA
Flashing (4)	Copper 304/316 SS HDG (3) HDG - ASTM A653 Class G185	Copper 304/316 SS HDG - ASTM A653 Class G185	Copper 304/316 SS HDG - ASTM A653 Class G185	304/316 SS	Copper 304/316 SS

Borates & Dricon® Fire Retardant Treated Wood (1)

	Indoors Always Dry (<15% MC)	Protected Can be damp for extended periods
AWPA Use Category	**UC1 / UCFA**	**UC2 / UCFB**
Fasteners	Mild Steel, EP HDG, MG Aluminum Copper 304/316 SS	HDG Aluminum Copper 304/316 SS
Connectors – Light gauge steel	EP HDG, MG 304/316 SS	HDG 304/316 SS
Connectors – Heavy duty welded steel	HDG, MG 304/316 SS	HDG -ASTM A123 304/316 SS
Flashing	HDG, MG Aluminum Copper 304/316 SS	HDG,MG Aluminum Copper 304/316 SS

Notes to Tables:

(1) Key to Metals in Tables

HDG: Hot-dipped galvanized steel
MG: Mechanically galvanized steel
EP – Electroplated
SS: Stainless Steel

Notes to Tables Cont.

(2) While hot-dipped galvanized fasteners are preferable, the use of non-galvanized or electroplated steel nails is acceptable when attaching joists, studs, or other framing to copper azole treated sill plate, provided the wood is initially dried after treatment and will remain dry in service, protected from weather and water. The use of ½" diameter and larger non-galvanized steel bolts is recognized in the International Residential Code; these are commonly used as foundation anchor bolts.

(3) The use of standard galvanized strapping is acceptable for fastening copper azole treated wood to foundations, provided that the wood is initially dry and will remain dry in service, protected from the weather and water.

(4) In wet situations, aluminum is subject to dissimilar metal corrosion when in contact with either CCA or copper azole treated wood. Aluminum should only be used in normally dry applications where a barrier can be installed that (a) provides complete separation of the aluminum (without penetrating fasteners) from the treated wood and that (b) will remain intact for the service life of the flashing. Aluminum nails, screws, fasteners and connectors should not be used in wood treated with copper based preservatives.

Barriers

Barriers may be used to enhance the corrosion protection of connectors in severe environments or critical applications. They may be used to extend the service life of galvanized steel or to help provide some protection when an application demands use of metals that are not specifically recommended. The barrier must be non-conductive and durable for the life of the application. Depending on the particular application, suitable barriers may include heavy plastic sheeting, rubber, vinyl, or even a high quality, non-permeable, industrial coating such as tar bitumen or epoxy.

Proprietary products

In today's market, many proprietary corrosion-resistant fasteners, connectors and flashing products are available. Specifiers or users of proprietary products should require testing that demonstrates the product is compatible with and has the intended service life in contact with the preservative treated wood.

Test development

The treating, fastener and connector industries are working together to develop improved corrosion test protocols for hardware in treated wood. As new tests are standardized and additional data is gathered from actual treated wood applications, the above recommendations may from time to time be revised.

NOTICE: CCA, borates and Dricon® chemicals are sold by Arch Wood Protection, Inc. The statements and recommendations made herein relating to wood treated with these products are made solely by Arch Wood Protection, Inc. Copper azole chemicals are sold by Arch Treatment Technologies, Inc. The statements and recommendations made herein relating to wood treated with these products are made solely by Arch Treatment Technologies, Inc. Information on all products has been included in one Technical Note for your convenience.