Common metal incompatibilities

by **James R. Kirby, AIA**

Q: *What common metal incompatibilities are found among roofing materials?*

A: There are three metal incompatibilities in roofing: metal to metal, metal to masonry and metal to wood.

Metal-to-metal incompatibilities are based on galvanic corrosion principles. Galvanic relates to a direct electrical current, and corrosion results when an electrical current develops between metals and the more anodic (i.e., active) metal decays. Oxygen and moisture are not necessary for galvanic corrosion to occur, but they accelerate the reaction.

Copper is one of the more noble (i.e., cathodic) metals and should be separated from other less noble (i.e., more active) metals to prevent galvanic reactions. When copper contacts galvanized steel (i.e., carbon steel with a zinc coating) or uncoated steel, the steel will corrode because it is less noble than copper. (Because their compositions are similar to copper, bronze and brass have nearly the same incompatibilities as copper.)

For example, if runoff from a copper roof system or gutter contacts a galvanized downspout, corrosion will occur. Similarly, galvanized fasteners anchoring copper gutters will corrode wherever the galvanized coating contacts copper. Also, runoff from a copper roof system or gutter will react with aluminum—an aluminum surface will pit (i.e., small areas of surface corrosion will appear) and become stained.

In addition, a copper roof system should not be fastened with aluminum nails—the nails will corrode. On the other hand, if an aluminum roof system is fastened with copper nails, virtually no corrosion will occur. This is because of the relatively large amount of aluminum (the less noble metal) vs. small amount of copper (the more noble metal). However, in coastal areas where high chlorine contents (e.g., airborne salts) exist, corrosion can occur anytime copper and aluminum contact. (Salt acts as a catalyst for galvanic reactions.)

Additionally, aluminum should not be fastened with uncoated steel fasteners—white or red deposits will develop at fastener locations; these deposits are the initial stages of corrosion. When galvanized-steel fasteners are used, their zinc coatings generally will protect uncoated aluminum from galvanic reactions.

Lead, lead runoff and possibly lead-based paints also will stain and corrode aluminum, potentially leaving pits in its surface. In addition, lead runoff will leave a white-ish stain on stainless steel and may stain glass. Both stains can be cleaned with denatured alcohol or mineral spirits.

Also, zinc sheets with condensation (e.g., on the underside of an architectural roof panel) that contact acidic wood (i.e., wood treated with a preservative), bitumen or copper will corrode quickly and severely.

To assist in preventing galvanic reactions between dissimilar metals, separating the metals is necessary. This may be accomplished by applying heavy coatings of paint; bituminous paint or material (e.g., felt); or, in the case of fasteners, a neoprene or rubber-type gasket.

However, there are some metals that perform well with others. ANSI or ASTM A167 300 series stainless steels are the most durable and corrosion-resistant metals for roofing applications. Stainless steel will be corrosion-resistant in combination with most common building materials and will not corrode in the presence of masonry alkalinity (i.e., pH level more than seven).

However, stainless steel can corrode in the presence of chloride salts or hydrochloric acids. Zinc chloride-based fluxes used in soldering and de-icing salts may damage stainless steel and should be removed from its surface. Along coastlines, airborne chloride salts exist naturally and can form localized corrosion cells that create small pits on the surface of stainless steel, indicated initially by small brown rust spots. As a result, it may be necessary to clean stainless-steel roofing materials (e.g., panels, flashings) periodically with mild abrasive cleaners and rinse the materials thoroughly.

Metal-to-masonry incompatibilities also can occur in a few instances. For example, aluminum will corrode in the presence of wet materials containing lime and cement (e.g., mortar); these materials' high alkalinity levels react with aluminum. Although prefinished aluminum offers some protection, scratches and exposed ends resulting from damage or on-site cuts will corrode.

Copper does not react specifically to alkalis in mortar, but copper's long-term performance can be adversely affected by large concentrations of chlorides. As a result, copper should not be used with mortar made with chloride additives.

Problems with metal and wood are common, too. NRCA recommends copper nails not be used as fasteners for western red cedar shakes or shingles. The natural resins in western red cedar can cause acid buildup when moisture is present and, consequently, copper corrosion. The copper-oxide runoff resulting from the corrosion process also can stain shakes or shingles. In addition, copper flashings that contact western red cedar can create an environment conducive to corrosion. Sheet copper, if used as flashing material for cedar roof systems, is recommended to be a minimum of 16 ounces per square foot (5 kg/m^2). PR

Each month in this column, NRCA's technical services staff will answer readers' technical questions. If you have a question, send it to Professional Roofing, *10255 W. Higgins Road, Suite 600, Rosemont, Ill. 60018-5607.*