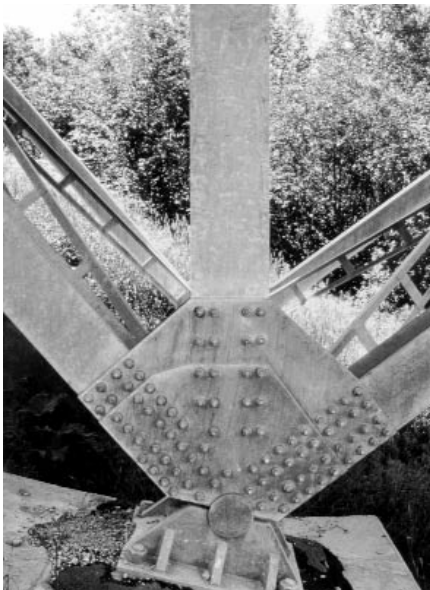


**Q** My company is designing some bridge connections and we are considering using hot-dip galvanized bolts. Having never specified for hot-dip galvanizing before, we are unfamiliar with the allowances we must make on nut and clearance hole sizes to accommodate for the increase in bolt diameter due to the galvanization. How much coating should we expect, and will the coating interfere with assembling the bolted connections?

**A** First, let's familiarize you with some basics of the hot-dip galvanized coating — it's formed by an interdiffusion reaction of iron and zinc. The nature of the reaction is that iron and zinc mix at the surface of the coating and form intermetallic layers. These alloy layers grow perpendicular to the steel and produce a uniform coating on all surfaces of the underlying steel, as well as corners and edges. Therefore, the coating is nearly the same thickness on threads as it is on the head of bolts or other flat surfaces.

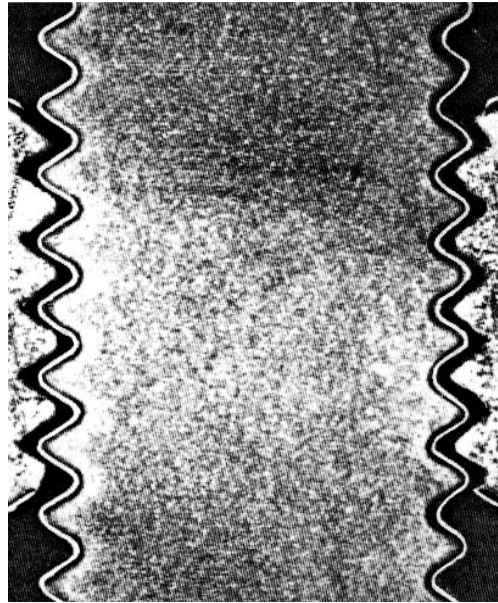


Coatings for hardware items and small parts are specified per ASTM A 153, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*. The process for producing clean thread coatings is to centrifuge the hot-dip galvanized part immediately after it comes out of the zinc bath to throw off any excess zinc from the

threaded areas. The threads are then smooth and consistent in coating thickness.

Typical coating thickness on bolts can range from 1.8 to 3.5 mils (0.045 to 0.09 mm), which can make standard bolt and nut tolerances difficult to maintain for correct assembly. If bolts are galvanized, then the nuts should be oversized to accommodate the 3.6 to 7.0 mils (0.09 to 0.18 mm) increase in bolt diameter after galvanizing (oversize tolerances are detailed in ASTM A 563, *Standard Specification for Carbon and Alloy Steel Nuts*).

If the nuts or tapped holes in a steel article are hot-dip galvanized, they should be retapped or rethreaded after galvanizing to remove the zinc coating and provide clear-



ance for the coated bolt. When the fastener system is assembled, the coating from the bolt will provide protection for the uncoated nut thread since zinc coatings cathodically protect uncoated steel. The retapping is done on the nut side so that no uncoated threads

on the bolts will be available to weather without galvanized protection. If retapping the nuts, it's important to note that all of the zinc coating must be removed from the inner threads. Standard practice for structural connections is to galvanize the nuts as blanks and then to tap the threads after galvanizing.

If the hole that you are designing is a clearance hole (a hole without threads) you can predict that a 7.2 to 14.0 mils (0.18 to 0.36 mm) allowance is required to accommodate the increased diameter of the bolt. This is because the mating surface of the clearance hole will also be galvanized to approximately the same thickness. Therefore, the diameter of the clearance hole will be reduced by twice the coating thickness and the diameter of the bolt will increase by twice the coating thickness. It is also important to consider that when increasing hole sizes to accommodate for galvanizing you are also decreasing the bearing surface area of the bolt head. This may prove to be a factor when preparing design calculations.

Using hot-dip galvanized fasteners for bolted connections is a very effective way to provide corrosion protection for your bridge. By making hole size allowances on the drawing board you will ultimately save time and money down the road by assisting in a quick, easy installation of your bridge.