Electroplating Thickness Is Not Uniform on Fasteners

By Joe Greenslade

Suppliers of electroplated fasteners are periodically confronted with complaints from customers who do not understand the true nature of electro-deposited finishes on fasteners, and in particular, the threads of fasteners. They incorrectly believe that plating covers a part with a uniform layer of finish on all surfaces of the part.

Figure 1, drawn by Michael Bernier, Quality Manager of Pilgrim Screw and a member of the ASME B1 committee, clearly shows how the thickness of an electroplated finish varies on different areas of an externally threaded fastener. Electroplating builds up more heavily on sharp edges such as thread crests; electro-plating also deposits more thickly on the part's extreme ends than it does in the part's middle.

This unevenness of deposition is a natural phenomenon of electroplating. Close controls of the plating process, including batch size, current density, solution composition, and plating time, can minimize the unevenness within limits, but this condition cannot be completely eliminated by the plater.

When trying to determine if a fastener is properly plated, it is important to be sure that the thickness is being evaluated in an appropriate location on the part. Misunderstandings regarding measurement location can be the source of a lot of confusion in determining the acceptability of plating thickness on a fastener. The thickness of plating is supposed to be evaluated on what is termed "significant surfaces." A significant surface is defined in most plating standards similarly to the way it is in Section 7.1.1 of ASTM B633.

"Significant surfaces may be defined as those normally visible, directly or by

Figure 1. *The uneven build-up of electroplated finishes on fasteners.*

reflection, which are essential to the appearance or serviceability of the article when assembled in normal position; or which can be a source of corrosion products that deface visible surfaces on the assembled article."

On bolts and screws, the significant surface is generally interpreted to be the top of the head of the part.

Purchasers of long fasteners with a diameter-to-length ratio greater than 1 to 6 need to understand that because plating build-up is thicker on the ends of parts than in their middle, it is possible to encounter thread gaging problems. Fully thread, long fasteners are particularly subject to thread gaging problems. In some cases, the plating thickness may be correct when measured on the top of the head and end of the screw, but may exhibit some non-coverage in the middle of the screw. If these parts are plated sufficiently to cover the middle of the screw, the parts may be overplated on the ends and may present thread gaging problems. When this condition occurs it may be necessary to make the screw's pitch diameter slightly undersized to achieve total surface coverage and maintain thread gaging acceptability. ASME B1.1 provides formulas for estimating the amount of thread undersizing needed to accommodate plating of various thicknesses.

When long parts are required to meet ASME B1.3, System 22 gaging requirements, the threads on the end may be within specification, but the threads in the middle may measure undersized on the pitch diameter. This is more of a potential problem when threads must meet the gaging requirements of Class 3A. Long plated parts that specify Class 2A threads have a better chance of meeting their thread size requirements because they have a wider tolerance than Class 3A threads. According to ASME B1.1 and B1.2, the after-plating thread acceptance criteria for Class 2A threads is 3A GO and 2A NoGo.

When this uneven plating coverage condition occurs, it is sometimes totally out of the control of the manufacturer and/or plater. In these cases, the purchaser must decide which out-ofspecification condition will be less detrimental or insignificant in their application. To eliminate non-coverage in the center of parts, the purchaser may have to accept thread sizes that slightly exceed the maximum limits on the starting threads of the part. When the thread's pitch diameter is within size on the end, but undersized in the middle, the purchaser can make a note on their print to indicate that thread acceptability will be determined by thread measurements taken within two diameters of the point end of the fastener. In some cases, changing the thread class from 3A to 2A may be sufficient to solve the problem.

When plating long fasteners, manufacturers cannot defy the laws of physics. In some cases, the purchaser will have to provide reasonable accommodations on their drawings so the parts they need to meet the requirements of their application can be manufactured. ❑

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Joe is an inventor, author, and lecturer. He holds eleven U.S. Patents, has written over 80 technical articles for industrial trade journals, and has spoken frequently at trade association meetings and technical the past ten years.

He is an Associate Member of the Industrial Fastener Institute and a member of the American Society of Mechanical Engineers B1 Thread Specification Committee. In 1992, Joe was recognized for his technical and innovative contributions to the fastener industry when, at age 44, he became the youngest person to be inducted into the National Industrial Fastener Show "Hall of Fame."