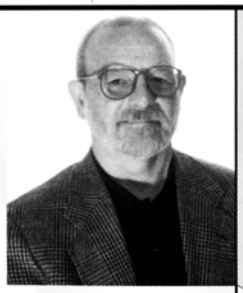
ASTM
Publishes Electroplating Standards Specifically for Threaded Fasteners



Joe Greenslade is President of Greenslade and Company, Inc. His company specializes in providing manufacturing tooling and inspection equipment to suppliers of screws, bolts, rivets, and nuts throughout the world. Greenslade is an associate member of the Industrial Fastener Institute (IFI), a member of the American Society of Mechanical Engineers B1 Thread Specification Committee, and a member of the Public Law 101-592 Task Force.

In 1998 the American Society for Testing and Materials (ASTM) first issued ASTM F1941 entitled "Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Screw Threads, UN/UNR)". In January of this year the 2001 ASTM Standards Book, Volume 01.08 was published containing a revised version of this standard plus a comparable standard to cover metric threaded fasteners. The new standard is ASTM F1941M-00 entitled "Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Metric)".

These two standards are applicable only to threaded fasteners. These specifications cover electrodeposited zinc, cadmium, zinc cobalt alloy, zinc nickel alloy and zinc iron alloy finishes as they relate to threaded fasteners. The specification provides four minimum thickness designations ranging from .0001 to .0005 inches (3μ to12μ and lists five different types of chromate finishes that can be added to the electrodeposited platings to increase the plating's corrosion resistance.

ASTM F1941 and ASTM F1941M address several specific issues related to threaded fasteners that will eliminate much of the past confusion resulting from the electroplating of threaded fasteners. These important issues are: the explanation of where to test plating thickness, thread fit requirements, baking and testing for hydrogen embrittlement risk management, and corrosion resistance requirements.

Greenslade & Company, Inc.
817-870-8888, 817-870-9199Fax
greensladeandconpany@sbcglobal.net

Inspect Plating Thickness On "Significant Surfaces"

Many disagreements regarding plating thickness have resulted from customers measuring thickness in one location and their suppliers measuring in another. Electrodeposited finishes do not apply uniformly on all areas of a part. Electrodeposited finishes are thicker on the part's extreme ends and on edges. Because of this natural lack of uniform deposition, it is extremely important that customers and suppliers measure plating thickness in the same locations on fasteners so that test results can be agreed up on.

ASTM F1941 and ASTM F1941M state that plating thickness must be measured on "significant surfaces". This term is defined as follows in Section 3.1.4:

Significant surface - significant surfaces are areas where the minimum thickness to be met shall be designated on the applicable drawing or by the provision of a suitably marked sample. However, if not designated, significant surfaces shall be defined as those normally visible, directly or by reflection, which are essential to the appearance or serviceability of the fastener when assembled in normal position, or which can be the source of corrosion products that deface visible surfaces on the assembled fastener. 【Figures 1】 and 【Figures 2】 illustrate significant surfaces on standard externally and internally threaded fasteners.

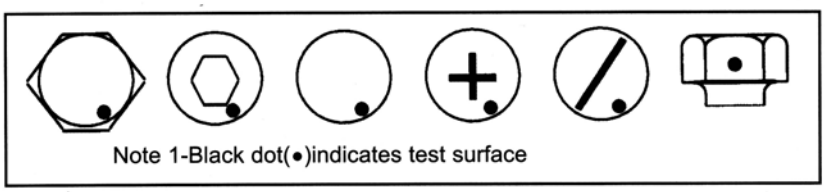


FIG. 1 Significant Surfaces on Externally Threaded Fasteners

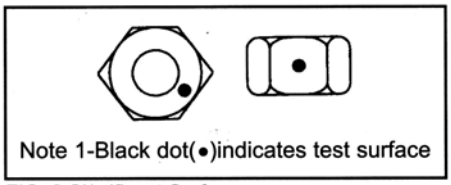


FIG. 2 Significant Surfaces on Internally Threaded Fasteners

Proper Thread Gauging Before And After Plating

Thread fit is a critical issue for threaded fasteners because over-plating threaded parts can result in components that will not assemble together.

Inch Threads: ASTM F1941 covers thread fit requirements inch threads in the following two paragraphs:

6.3.1.2 **External Threads** - Maximum coating thickness at high current density threaded tips must provide for class 3A GO acceptance gauge acceptance.

6.3.1.3 **Internal Threads** - Maximum coating thickness of internal threads must provide for class1B, 2B, or 3B Go thread acceptance.

Greenslade & Company, Inc.
817-870-8888, 817-870-9199Fax
greensladeandconpany@sbcglobal.net

ASTM F1941 also provides a helpful chart in Annex X3 that indicates the maximum plating thickness that can be applied to class 1A and 2A threads of all pitches without exceeding the 3A GO gaging requirements after plating. The Appendix section X3.2 makes an often confused issue very clear by specifically stating that inch threads, which are 2A before plating, are gaged using Class 3A Go gages and 2A Not-Go gauges after plating.

Metric Threads: ASTM F1941M covers thread fit requirements metric threads in the following two paragraphs:

6.3.1.2 **External Threads** - Maximum coating thickness at high current density threaded tips must provide for basic (tolerance position h) GO acceptance gauge acceptance. Therefore, the thread after coating is subject to acceptance using a 6h GOO gauge for plated 6g class external threads and 4h6h GO gauge for plated 4g6g external threads respectively.

6.3.1.3 **Internal Threads** - Maximum coating thickness of internal threads must provide for basic (tolerance position H) Go thread acceptance. Therefore, the thread after coating is subject to acceptance using a class 6H GO gauge for 6H class internal threads.

ASTM F1941 also provides a helpful chart in Annex X3 that indicates the maximum plating thickness that can be applied to class 1A and 2A threads of all pitches without exceeding the 3A GO gaging requirements after plating. The Appendix section X3.2 makes an often confused issue very clear by specifically stating that inch threads, which are 2A before plating, are gaged using Class 3A Go gages and 2A Not-Go gauges after plating.

Metric Threads: ASTM F1941M covers thread fit requirements metric threads in the following two paragraphs:

6.3.1.2 **External Threads** - Maximum coating thickness at high current density threaded tips must provide for basic (tolerance position h) GO acceptance gauge acceptance. Therefore, the thread after coating is subject to acceptance using a 6h GOO gauge for plated 6g class external threads and 4h6h GO gauge for plated 4g6g external threads respectively.

6.3.1.3 **Internal Threads** - Maximum coating thickness of internal threads must provide for basic (tolerance position H) Go thread acceptance. Therefore, the thread after coating is subject to acceptance using a class 6H GO gauge for 6H class internal threads.

Greenslade & Company, Inc.
817-870-8888, 817-870-9199Fax
greensladeandconpany@sbcglobal.net

ASTM F1941M also provides Table X3.1 in Appendix X3 that indicates the maximum plating thickness that can be applied to class 6g and 4g6g coarse pitch threads without exceeding the 6h or 4h6h GO gaging requirements after plating respectively. The Appendix section X3.3 makes an often-confused issue very clear by specifically stating that metric threads, which are 6g before plating, are gaged using Class 6h Go gages and 6g Not-Go gages after plating.

Risk Management Issues For Hydrogen Embrittlement

Section 6.4 of both ASTM F1941 and F1941M cover hydrogen embrittlement issues very thoroughly. This section makes the following points;

1. Fasteners having hardness of Rockwell C40 and above, all case hardened parts, and parts having captivated hardened washers must be baked to minimize the risk of hydrogen Embrittlement.
2. Typically, baking should be done within 4 hours after plating, with one hour preferred. Parts should be baked for 2 to 24 hours at a temperature between 350 and 450 degrees F. The supplier and purchaser should agree on the specific bake times and temperatures to be used on their products.
3. Fasteners above Rockwell C 40 must be tested unless the plating bath has been qualified in accordance with the test methods in ASTM F1940. The effectiveness of the baking process in relieving hydrogen from the steel fasteners must be verified using one of the test methods in ASTM F606, F1624, F519, or NASM 1312-5. The testing of parts below Rockwell C40 is not mandatory.
4. Baking must be done before applying chromate finishes to parts. Temperatures above 150 degrees F will damage the chromates and make them ineffective.

Performance Requirements For Corrosion Resistance

Section 9.3 of ASTM F1941 and F1941M state that fasteners must be subjected to salt spray corrosion resistance tests only if specifically required by the customer's purchase order. If parts are required to pass salt spray tests, the corrosion requirements only apply to those areas on the parts that meet the specification's definition of "significant surface".

Parts are required to age for 24 hours after plating before being corrosion tested. The salt spray testing method used must meet the requirements of ASTM B117. The four tables in Annex A1 in both standards specify the minimum number of hours of salt spray resistance that is required for each of the electrodeposited platings having the various thicknesses, and added chromate finishes. As an example, .0002 inches (5 (m) of zinc on steel with a clear chromate, designated as FE/ZN 5A, must withstand 24 hours of salt spray resistance before exhibiting red rust while the same thickness of zinc with an opaque (olive green) chromate, designated as FE/ZN 5D, must withstand 96 hours of salt spray resistance before exhibiting red rust.

The ASTM F1941 AND F1941M electroplating standards are the first produced exclusively for threaded fasteners. They thoroughly address areas of misunderstanding that have existed between fastener customers and suppliers in the past. Fastener suppliers should obtain a copy of this specification immediately and should start to follow them

while urging their customers to use these on future purchase orders for electroplated threaded fasteners. These standards are included in the 2001 Volume 01.08 of the ASTM Standards and can be obtained from the ASTM web sight at www.astm.org.

Greenslade & Company, Inc.
817-870-8888, 817-870-9199Fax
greensladeandconpany@sbcglobal.net