MIL-P-27418(USAF)
14 July 1967

# MILITARY SPECIFICATION

## PLATING, SOFT NICKEL (ELECTRODEPOSITED, SULFAMATE BATH)

1. SCOPE

1.1 Scope. This specification covers the processes and requirements for soft nickel plating.

2. APPLICABLE DOCUMENTS

Not applicable

3. REQUIREMENTS

3.1 Materials. The materials used shall be such as to produce coatings which meet the requirements of this specification.

3.2 Workmanship.

3.2.1 Basis metal. The basis metal shall be free from visible defects that will be detrimental to the performance of the plating. Articles to be plated shall be stress relieved, cleaned, etched, pickled, plated, and annealed as required to produce plating as specified herein.

3.2.2 Plating. The nickel plating shall be smooth, columnar crystalline (before annealing - 6.3), adherent, and free from visible blisters, pits, nodules, porosity, indications of burning and excessive edge buildup, and other defects. Slight discoloration resulting from annealing, shall not be cause for rejection. All details of workmanship shall conform to the best practice for high-quality plating.

3.3 General requirements.

3.3.1 Unless otherwise specified, the plating shall be applied after all basis-metal heat treatments and mechanical operations such as machining, brazing, welding, forming, and perforating on the article have been completed.

3.3.2 All articles shall be given a suitable stress-relief heat treatment prior to cleaning and plating. The temperature shall be such that maximum stress relief is obtained without reduction in hardness to less than the specified minimum.

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3.3.3 Unless otherwise specified, the plating shall be electrodeposited in an all-sulfamate, chloride-free nickel bath (6.3).

3.3.4 All articles shall be annealed in a vacuum furnace after plating to obtain the proper plating hardness.

3.4 Detail requirements.

3.4.1 Plating thickness. Unless otherwise specified, the plating shall be 0.0020 inch ± 0.0003 inch thick on all surfaces to be plated which can be touched by a ball 1/16 inch in diameter.

3.4.2 Plating boundaries. Unless otherwise specified, boundaries of the plating which covers only a portion of the surface shall be free from beads, nodules, jagged edges, and other irregularities, and shall blend smoothly into the unplated surface.

3.4.3 Plating hardness. Unless otherwise specified, the Knoop hardness of the plating after annealing shall not exceed 150 with a 500-gram load.

3.4.4 Plating adhesion. When examined at a magnification of approximately 4 diameters, adhesion of the nickel plating shall not show separation from the basis metal when subjected to the test specified in 4.4.2. The formation of cracks in the basis metal which do not result in flaking, peeling, or blistering of the coating shall not be considered as nonconformance to this requirement.

3.4.5 Process deviations. Deviations from the specified plating and annealing requirements of this specification may be authorized by the Government inspector or the procuring activity provided the contractor demonstrates that coatings thus produced are equivalent (6.3), for the purpose intended, to coatings produced under the specified conditions. Doubtful cases shall be referred to the procuring activity for decision.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified by the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Separate specimens. When the plated articles are of such form as to be not readily adaptable to a test specified herein, or at the discretion of the inspector for destructive tests for the sampling of small lot sizes, or as otherwise specified herein, the test shall be made by the use of spearate specimens plated and annealed concurrently with the articles represented. The separate specimens shall be of a basis metal equivalent to that of the articles represented. "Equivalent" basis metal includes chemical composition, heat treatment, and finish of surface prior to plating. Due to the impracticability of forging separate test specimens, equivalent hot-rolled steel specimens may be used to represent forged steel articles. The separate specimens shall be strips approximately 1 inch wide, 4 inches long, and 0.04 inch thick. These specimens shall be introduced into a lot prior to the cleaning operations preliminary to plating and annealing processes. Conditions affecting the plating and annealing of the specimens including the spacing and positioning with respect to anodes and to other objects being plated, and with respect to the heating surfaces, shall correspond as nearly as possible to those affecting the significant surfaces of the articles represented.

4.3 Sampling.

4.3.1 Lot. A lot shall consist of plated articles of approximately the same size and shape, plated and annealed concurrently and submitted for inspection at one time. Lot size shall not exceed 500 articles.

4.3.1.1 Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order.

4.3.2 Sampling procedures for visual examination. A sample shall be taken from each lot by taking at random from the lot the number of articles indicated in table I. The lot shall be accepted or rejected on the basis of the sample according to the procedures in 4.3.2.1.

TABLE I

Sampling for visual inspection

| Number of articles in lot | Number of articles in sample (randomly selected) | Acceptance number= (maximum number of sample articles nonconforming to any test) |
|---|---|---|
| 15 or less | 1/ 7 | 0 |
| 16 to 40 | 10 | 0 |
| 41 to 110 | 15 | 0 |
| 111 to 300 | 25 | 1 |
| 301 to 500 | 35 | 1 |

1/ If the number of articles in the lot is less than 7, the number or articles in the sample shall equal the number of articles in the lot.

4.3.2.1 Visual inspection. The number of sample articles indicated in table I shall be taken at random from the lot to be inspected and examined visually and compared with requirements of 3.2.7 after annealing. If the number of nonconforming articles in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected.

4.3.3 Sampling procedure for hardness, adhesion, and coating thickness tests. A small, random sample of articles shall be selected from each lot by the Government inspector and three separate specimens shall be prepared in accordance with 4.2 to represent each lot. The number of articles in the sample shall be determined by the procuring activity or shall be left to the discretion of the inspector. Each randomly selected sample article shall be subjected to the thickness test and each of the three separate specimens shall be subjected to the hardness, adhesion, and thickness tests.

4.3.3.1 Hardness. Each specimen shall be tested in accordance with 4.4.1 in several locations at which the plating hardness would be expected to be maximum. If the hardness at any place on any specimen is greater than the specified hardness, the lot shall be rejected.

4.3.3.2 Adhesion. Each specimen shall be tested in accordance with 4.4.2. Failure of one or more of the test specimens shall constitute failure of the lot.

4.3.3.3 Thickness (destructive test). Each article and specimen shall be tested in accordance with 4.4.3 in several locations at which the plating thickness would be expected to be minimum. If the plating thickness at any place not affected by the hardness or adhesion tests is greater than or less than the specified thickness limits, the lot shall be rejected.

4.4 Test methods.

4.4.1 Hardness. Standard hardness testing procedures shall be used to determine the Knoop hardness of the coating within ± 5 percent of its true hardness.

4.4.2 Adhesion. The test specimens shall be bent repeatedly through an angle of 180 degrees on a diameter equal to the thickness of the specimen until fracture of the basis metal occurs. Following fracture of the basis metal, it shall not be possible to detach any appreciable areas of the coating with a sharp instrument.

4.4.3 Thickness. Standard metallographic procedures shall be used to determine the coating thickness with a microscope. The specific method and equipment used shall be such that the coating thickness shall be determined within ± 10 percent of its true thickness.

4.5 Replating. Unless otherwise specified, plated articles which have been rejected or withdrawn because of the presence of plating defects may be resubmitted after stripping, replating, and reannealing the entire lot. Complete details of the replating and reannealing shall be furnished to, and be approved by, the inspector or procuring activity.

5. PREPARATION FOR DELIVERY

5.1 There are no general packaging, packing, or marking requirements applicable to this specification. Packaging, when required shall be as specified by the procuring activity.

6. NOTES

6.1 Intended use. The plating conforming to this specification is intended to facilitate the formation of a seal between two metallic surfaces.

6.2 Ordering data. Requisitions, contracts, and orders should be accompanied by drawings of the articles to be plated. The procurement documents should specify the following:

(a) Title, number, and date of this specification.

(b) Instructions concerning the areas to be plated, deviations from the specified plating thickness, and any other necessary information pertinent to the plated surfaces.

(c) Instructions concerning the number of articles to be selected for the thickness test (4.3.3).

(d) Instructions concerning samples for approval (6.6).

6.3 Plating type. According to considerable laboratory testing, the nickel plating best suited to creating a seal when yielded against a metallic surface has a columnar crystalline structure before annealing. This structure is illustrated in figure 1. When a process other than the one specified is recommended by the contractor, the resulting structure of the plating before annealing should closely approximate the structure shown in figure 1.

6.4 Plating hardness. The acceptance of the plating is determined according to this specification by tests made after annealing. However, when the Knoop hardness of the plating prior to annealing is less than 300 with a 500-gram load, the eventual acceptability of the plating after annealing is indicated (3.4.3).


Figure 1. Columnar crystalline structure of soft nickel plating prior to annealing. (500X)

6.5 Plating thickness. The dimensional tolerances of most seals do not allow for wide variations in plating thickness. The plating thickness covered by this specification (0.0020 inch) has been selected to provide maximum uniformity and minimum shear stresses during deformation. When other thicknesses are desired, adequate tests must be made to determine the performance of the desired thickness.

6.6 Samples. This specification describes the characteristics necessary to secure the desired plating. Unless otherwise specified, no samples will be necessary prior to award to determine compliance with this specification. If, for any particular purpose, samples with bids are necessary, they should be specifically asked for in the invitation for bids, and the particular purpose to be served by the bid sample should be definitely stated, the specification to apply to all other respects.

Custodians:

Air Force - 12

Preparing Activity:

Air Force - 12

Review activities:

Air Force - 11, 14, 19, 69, 85

Civilian Agencies Interest:

NAS

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# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

*(See Instructions – Reverse Side)*

| 1 DOCUMENT NUMBER | 2 DOCUMENT TITLE |
|---|---|
| MIL-P-27418(AS) | PLATING, SOFT NICKEL (ELECTRODEPOSITED, SULFAMATE BATH) |

| 3a. NAME OF SUBMITTING ORGANIZATION | 4 TYPE OF ORGANIZATION *(Mark one)* |
|---|---|
| | ☐ VENDOR |
| | ☐ USER |
| b ADDRESS *(Street, City, State, ZIP Code)* | ☐ MANUFACTURER |
| | ☐ OTHER *(Specify)* _____ |

5 PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6 REMARKS

| 7a NAME OF SUBMITTER *(Last, First, MI)* – Optional | b WORK TELEPHONE NUMBER *(Include Area Code)* – Optional |
|---|---|
| c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional | 8 DATE OF SUBMISSION *(YYMMDD)* |

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