

ASME B18.18.2-2009

[Revision of ASME/ANSI B18.18.2M-1987 (R2005)]

Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

AN AMERICAN NATIONAL STANDARD



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FOREWORD

American National Standards Committee B18 for the standardization of bolts, screws, nuts, rivets, and similar fasteners was organized in March 1922 as Sectional Committee B18 under the aegis of the American Engineering Standards Committee (later the American Standards Association, then the United States of America Standards Institute and, as of October 6, 1969, the American National Standards Institute, Inc.) with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors.

Subcommittee 18 of Committee B18 was established in September 1978 to develop a document to cover the quality assurance provisions for internally and externally threaded metric fasteners and accessories or associated parts.

At the March 1979 meeting of Subcommittee 18, it was agreed that the quality assurance document should be circulated for subcommittee consideration as a proposed standard. Subcommittee acceptance of the content ensued and the document was approved by letter ballot to the American National Standards Committee B18 on March 21, 1980.

The Standard was subsequently approved by the Secretariat and submitted to the American National Standards Institute for redesignation as an American National Standard it was designated ANSI B18.18.2M-1982 and approved on September 14, 1982.

A periodic review of the Standard, undertaken by the Subcommittee in 1985, resulted in agreement that the document be revised to allow it to be used for inch as well as metric products.

This was done by deleting the word "metric" from the title as well as from each place in the Standard where it would inhibit the use of the document for inch as well as metric products. By retaining the "M" in the designator, the Standard can be used for both inch and metric products without having to change any references made. A proposal containing these changes, as well as editorial corrections, was prepared and balloted by letter ballot to ASME Committee B18. Following approval by ASME, the proposal was submitted to the American National Standards Institute and designated an American National Standard on January 16, 1987.

A periodic review of the Standard, undertaken by the Subcommittee in 2008, resulted in agreement that the document be revised. The "M" in the designation has been removed because this Standard is not solely related to metric fasteners. The restriction of lot size of 250,000 pieces was removed. The sample sizes were revised to be aligned with those used in ASTM F 1470. This Standard is now intended to be directly related to determining the acceptability of dimensional characteristics and the acceptance of chemical and physical characteristics are directed to ASTM F 1470 when applicable. A proposal containing these changes, as well as editorial corrections, was prepared and balloted by letter ballot to ASME Committee B18.

This Standard was approved by the American National Standards Institute on July 14, 2009.



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Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners

(The following is the roster of the Committee at the time of approval of this Standard.)

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Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

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The request for an interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject: Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition: Cite the applicable edition of the Standard for which the interpretation is being requested.
Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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INSPECTION AND QUALITY ASSURANCE FOR HIGH-VOLUME MACHINE ASSEMBLY FASTENERS

1 GENERAL INFORMATION

1.1 Basic Plan Structure

This Standard outlines a Quality Assurance Plan for internally and externally threaded fasteners and accessories or associated parts. Provisions are included for sampling plans, inspection frequencies, control procedures, and record keeping.

Included in this plan are fasteners such as those where a more detailed inspection would enhance mass assembly operation. The quality assurance plan for these fasteners relies primarily on increased final inspection rather than on documented in-process control.

This Standard will be used in conjunction with other accepted standards for product, testing, gaging, and material and, therefore, those provisions as well as packaging are not included herein.

1.2 Inspection Levels

The substantial difference in importance to the user of various characteristics and the dissimilar degrees of control in manufacture make impractical the subjecting of all characteristics to the same degree of inspection. Therefore, three inspection levels have been provided.

Any additional characteristics deemed applicable by the user that do not appear in the plan shall be explicitly designated by the user, preferably on engineering drawings and related specifications by the appropriate code letter at the time of ordering (see Nonmandatory Appendix B). To assist in arriving at the most appropriate inspection level, Fig. A-1 included in Nonmandatory Appendix A is recommended for guidance.

1.3 Measuring and Testing Equipment

All measuring and testing equipment shall be systematically maintained and controlled as specified in ISO 17025.

1.4 Basic Plan Outline

The basic plan outline as shown in Fig. 1 is included to enhance understanding and use.

2 FASTENERS FOR HIGH-VOLUME MACHINE ASSEMBLY APPLICATIONS

2.1 Scope

This Standard is an Acceptance Sampling Plan for high-volume machine assembly fasteners, accessories, and associated parts. It establishes specific inspection functions that must be performed on the finished product or at the appropriate stage of manufacturing with the objective of ensuring that the accepted product conforms to all the requirements of engineering drawings, related standards, and/or specifications.

This plan does not necessitate in-process control; however, the producer, at his discretion, may apply in-process control. Adherence to the requirements of this plan does not release the contractor from the responsibility of exercising due care in the production of all parts to the requirements established for all characteristics shown on engineering drawings and related specifications.

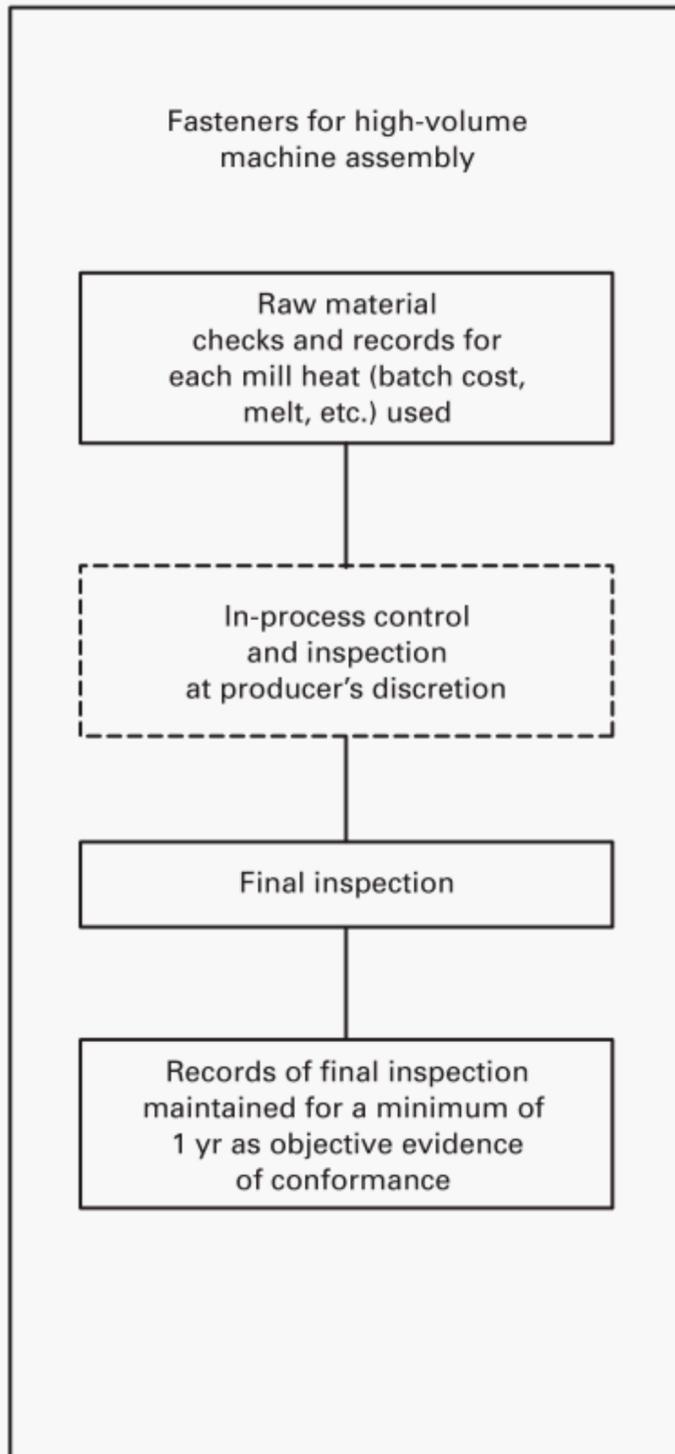
2.2 Applicable Characteristics

Unless designated characteristics are specifically specified in the product standard, the applicable characteristics include all characteristics of a part that are described by engineering drawings and related specifications. Three levels of inspection — A, B, and C — are provided in the plan. Alternate levels may be designated by the user if required. Refer to Fig. A-1 in Nonmandatory Appendix A to establish alternate levels as required. Any additional characteristic(s) deemed applicable by the user and not appearing in the general plan, or characteristics for which the user requires an inspection level other than that designated in the plan, must be explicitly requested by the user and shown on drawings or specifications by the appropriate code letter at the time of ordering (see Nonmandatory Appendix B).

2.3 Lot Definition

A lot is a quantity of product of one part number made from one heat of raw material by the same production process and subsequently submitted for final inspection at one time. In the case of fasteners assemblies, such as screw and washer assemblies, the manufacturer shall maintain lot traceability for all components.



Fig. 1 Basic Plan Outline

2.4 Records

The supplier shall maintain and provide the purchaser logs and records of inspections and tests as required by this plan if requested. Such records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities of material or parts approved and rejected, and the nature of the corrective action taken, as appropriate. Records shall also include the disposition of rejected parts in accordance with para. 2.9 and shall be maintained for a minimum of 1 yr from the date of shipment of the parts.

2.5 Purchased Accessories and Parts

Accessories, services, and partially fabricated parts (e.g., washers, nuts, blanks, heat treating, plating, etc.) may be purchased by the prime contractor from subcontractors for use in the production of fasteners, provided the following conditions and requirements are met:

(a) The prime contractor shall be responsible to the user for the quality of the final product.

(b) The prime contractor shall be responsible for the implementation of all requirements of this plan, including records.

(c) All lots that are heat treated and/or finished by a subcontractor and all lots that are processed by a subcontractor following heat treatment and/or finishing operations shall undergo final inspection by the subcontractor or the prime contractor.

2.6 Raw Material

2.6.1 General. Raw material (rod, wire, or bar) shall be reviewed to determine that each coil or bundle has a mill identification and that each heat (batch, melt, cast, etc.) is accompanied by a mill certification of analysis or the equivalent. The raw material or its accompanying mill certification shall be inspected prior to release for fabrication to verify that it conforms to the material requirements specified.

2.6.2 General Quality. One fastener, taken at random from representative coils of rod or wire or from bundles of bars, shall be visually inspected to verify the general quality of the raw material and its condition following the forming process. The part shall be examined for evidence of pipe, cracks, seams, and other surface discontinuities according to applicable specifications.

2.7 Final Inspection

Each lot of fasteners shall be subjected to a final inspection. The final inspection is intended to verify lot identification and to inspect designated characteristics for conformance to related standards, specifications, and engineering drawings. Final inspection of any characteristic may be conducted at any stage of manufacturing

after which that characteristic will not be altered. Records of final inspection shall be maintained in accordance with para. 2.4. The dimensional final inspection requirements are given in Table 1. Sample sizes are then determined in accordance with Table 2. Chemical, physical, and mechanical final inspection requirements are specified in ASTM F 1470.

If a documented, verifiable, statistically based in-process inspection system is used by the fastener manufacturer, inspection sample sizes and reporting shall be in accordance with specified quality systems such as ASME, ASTM, or ISO.

2.8 Acceptance and Rejection

2.8.1 Basis of Rejection. Any coil of rod or wire or bundle of bars failing to meet the requirements of para. 2.6 shall be held for disposition.

2.8.2 Acceptance Criteria

2.8.2.1 Dimensional. If a single nonconforming characteristic is found in final inspection, the lot shall be held for disposition in accordance with para. 2.9.

2.8.2.2 Chemical and Mechanical. Chemical, mechanical, and other physical requirements are to be accepted per the requirements of ASTM F 1470.

2.8.3 Customer Inspection. If on receipt of the material the user discovers a single nonconforming part, he may sample the lot for such nonconforming characteristic(s) in accordance with ASME B18.18.1.

2.9 Disposition of Nonconforming Materials or Parts

Records of disposition shall be maintained in accordance with para. 2.4.

2.9.1 Manufacturer's Options. The manufacturer has the choice of the following options in the disposition of those materials or parts that have been found to contain discrepancies within his plant:

- (a) They may be scrapped.

- (b) They may be 100% sorted and all nonconforming parts removed.

- (c) They may be reworked or reprocessed to correct the nonconforming characteristic(s).

- (d) The customer may be informed of the rejectable items and his advice requested on their disposition.

If the customer considers that the degree to which the characteristic(s) deviates from specified requirements will have no significant effect on the performance of the parts in their service application, the customer may authorize release of the parts or materials for completion of production or for shipment as applicable.

2.9.2 Customer's Options. The customer shall establish agreement with the manufacturer on one of the following options for the disposition of those lots or parts that have been rejected after receipt from the manufacturer:

- (a) They may be scrapped.

- (b) They may be 100% sorted and all nonconforming parts removed.

- (c) They may be reworked or reprocessed to correct the nonconforming characteristic(s).

- (d) If the customer considers that the degree to which the characteristic(s) deviates from specified requirements will have no significant effect on the performance of the parts in their service application, the customer may authorize release of the parts or materials for use and advise the manufacturer.

- (e) They all may be returned.

2.9.3 Reinspection. All pieces that have been sorted and/or reworked in accordance with para. 2.9.1 or para. 2.9.2 shall be resubmitted for lot sampling and inspection in accordance with para. 2.7 for the characteristic(s) found nonconforming and all other characteristics that would be affected by the repair or reprocessing operation(s). If no parts in the sample inspected are found nonconforming, the material may reenter the production flow or may be approved for delivery or use as applicable.

Table 1 Final Inspection — Machine Assembled and Other Special Purpose Fasteners — Nondestructive Tests

| Characteristic | | Inspection level | Internally Threaded Parts | Externally Threaded Parts |
|----------------|---------------------------------|------------------|---------------------------|---------------------------|
| 1 | Body diameter | C | NA | WA |
| 2 | Length | B | NA | WA |
| 3 | Width across flats | B | WA | WA |
| 4 | Width across corners | C | WA | WA |
| 5 | Head or nut thickness | C | WA | WA |
| 6 | Wrenching height | B | WA | WA |
| 7 | Angularity of bearing surface | C | WA | WA |
| 8 | Bearing surface diameter | C | WA | WA |
| 9 | Head diameter | C | NA | WA |
| 10 | Flange diameter | C | WA | WA |
| 11 | Flange thickness | C | WA | WA |
| 12 | Recess penetration | A | NA | WA |
| 13 | Paint diameter | B | NA | WA |
| 14 | Countersink diameter and depth | C | WA | WA |
| 15 | Thread acceptability [Note (1)] | C | WA | WA |
| 16 | Total thread length | B | NA | WA |
| 17 | Grip length | B | NA | WA |
| 18 | Slot width | A | WA | WA |
| 19 | Slot depth | A | WA | WA |
| 20 | Slot alignments and location | B | WA | NA |
| 21 | Diameter of undercut | C | NA | WA |
| 22 | Depth of undercut | C | NA | WA |
| 23 | Washer O.D. | C | WA | WA |
| 24 | Washer thickness | C | WA | WA |
| 25 | Visual inspection [Note (2)] | A | WA | WA |

GENERAL NOTES:

- (a) WA — when applicable; NA — not applicable.
 (b) Refer to para. 2.8.2 for acceptance criteria. Refer to Table 2 for sample size.

NOTES:

- (1) ANSI/ASME B1.3M or other applicable standards and at the appropriate inspection level (B or C).
 (2) Visual inspection for grade and source identification, presence of finish, duds, surface discontinuities, head and/or flange eccentricity, flange flatness, radius under head, type of washer, presence of locking feature, closeness of thread to head, and general workmanship.



Table 2 Sample Size

| Lot Size | Sample Size | | |
|--------------------|-------------|----|---|
| | A | B | C |
| 1 to 2 | 2 | 1 | 1 |
| 3 to 15 | 3 | 2 | 1 |
| 16 to 25 | 4 | 3 | 1 |
| 26 to 50 | 5 | 4 | 1 |
| 51 to 90 | 6 | 5 | 2 |
| 91 to 150 | 7 | 6 | 2 |
| 151 to 280 | 10 | 7 | 2 |
| 281 to 500 | 11 | 9 | 3 |
| 501 to 1,200 | 15 | 11 | 3 |
| 1,201 to 3,200 | 18 | 13 | 3 |
| 3,201 to 10,000 | 22 | 15 | 4 |
| 10,001 to 35,000 | 29 | 15 | 4 |
| 35,001 to 150,000 | 29 | 15 | 5 |
| 150,001 to 500,000 | 29 | 15 | 6 |
| 500,001 and over | 29 | 15 | 7 |

GENERAL NOTES:

- (a) The acceptance number in all cases is zero defects.
- (b) Suppliers shall furnish certified test results from which the shipping lots originated. If certified test reports are not available, then the supplier must default to Sample Size C and conduct the test required.



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NONMANDATORY APPENDIX A INSPECTION LEVEL DECISION

Fig. A-1 Inspection Level Decision

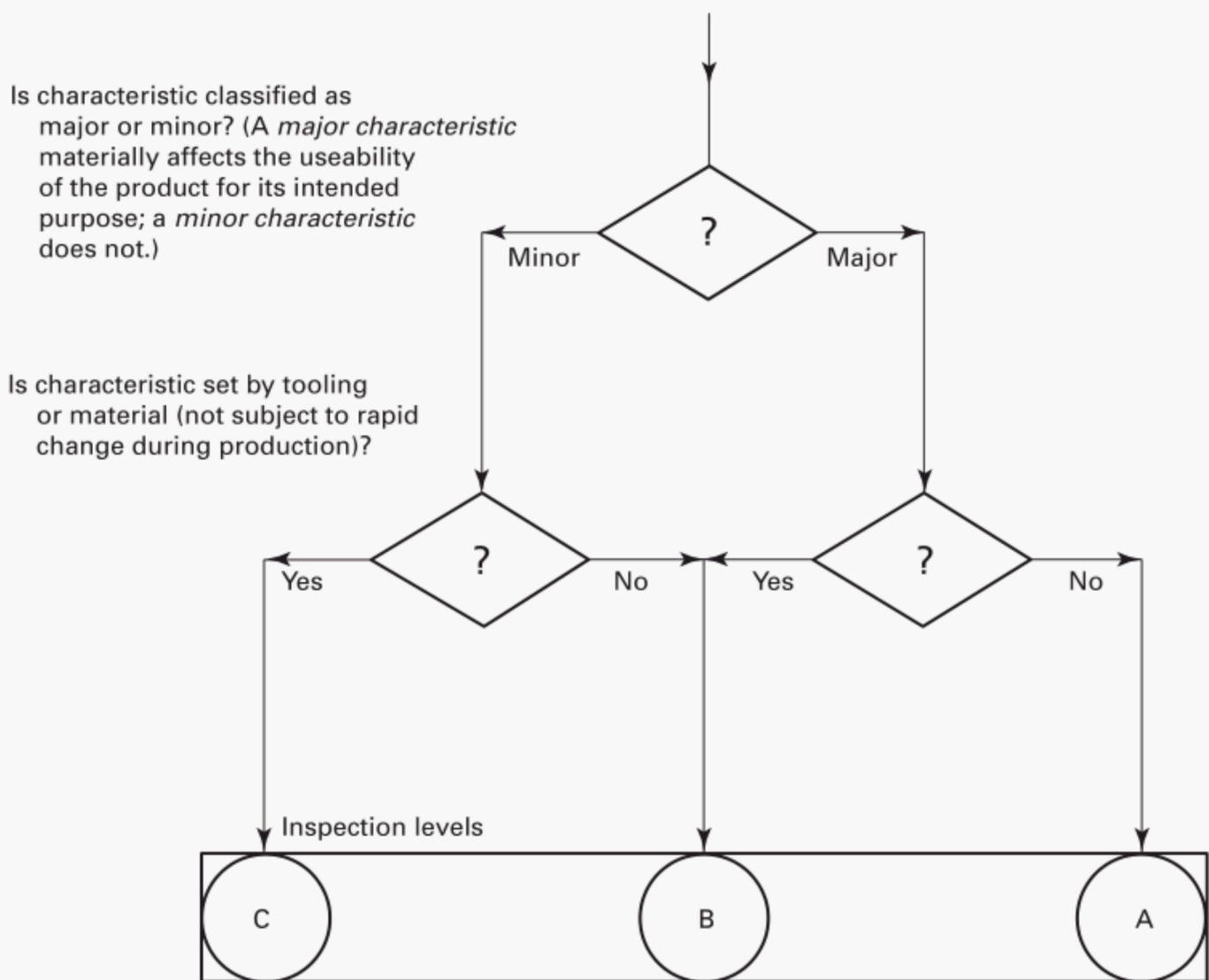


Table A-1 Suggested Equipment and Processing Control Checks

| Finishing Operation | Control Check | | | | | | | | | | | | | | | | | |
|-------------------------------------|---------------|-------|------|-------|-------|--------------|------------|-------|-----------------------|------|-------|-------|------|----------------------------|-------------|-------|------------|--------------------------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1. Zinc electrodeposited plating | Daily | Daily | FSTD | NA | NA | Daily | Daily | Daily | As added to each tank | FSTD | Daily | Daily | FSTD | As req'd based on analysis | WA each lot | NA | [Note (1)] | 2 pieces per line per shift |
| 2. Cadmium electrodeposited plating | Daily | Daily | FSTD | NA | NA | NA | Daily | Daily | As added to each tank | FSTD | Daily | Daily | FSTD | As req'd based on analysis | WA each lot | NA | [Note (1)] | 2 pieces per line per shift |
| 3. Copper electrodeposited plating | Daily | Daily | NA | NA | NA | Every 2 days | Daily | NA | As added to each tank | FSTD | Daily | Daily | FSTD | As req'd based on analysis | WA each lot | NA | [Note (1)] | NA |
| 4. Nickel electrodeposited plating | NA | Daily | NA | NA | NA | NA | Daily | NA | As added to each tank | FSTD | Daily | Daily | FSTD | As req'd based on analysis | WA each lot | NA | [Note (1)] | WA 2 pieces per line per shift |
| 5. Chrome electrodeposited plating | NA | Daily | NA | NA | NA | NA | Daily | NA | As added to each tank | FSTD | Daily | Daily | FSTD | As req'd based on analysis | WA each lot | NA | [Note (1)] | WA 2 pieces per line per shift |
| 6. Zinc phosphate coating | Daily | Daily | NA | Daily | Daily | NA | Each shift | NA | As added to each tank | NA | NA | Daily | FSTD | As req'd based on analysis | WA each lot | NA | [Note (2)] | 2 pieces per line per shift |
| 7. Post plating lubrication | NA | NA | NA | NA | NA | NA | NA | NA | As added to each tank | NA | NA | Daily | NA | As req'd based on analysis | NA | Daily | NA | NA |

GENERAL NOTE: WA — when applicable; NA — not applicable; FSTD — frequency sufficient to demonstrate control

NOTES:

(1) For hand line operations, one piece per barrel; for automatic line operations, five pieces at start of each lot.

(2) Check daily coating weight only.



NONMANDATORY APPENDIX B ORDERING INFORMATION

B-1 SPECIFICATIONS

When ordering, specify

(a) number and title of document (e.g., ASME B18.18.2, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners)

(b) exceptions (e.g., thread acceptability shall be based on the thread acceptability paragraph in ASME B1.3 with an A inspection level)



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