AN AMERICAN NATIONAL STANDARD

# Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

## ASME/ANSI B18.18.2M-1987

**REAFFIRMED 1999**

FOR CURRENT COMMITTEE PERSONNEL
PLEASE SEE ASME MANUAL AS-11

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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## FOREWORD

(This Foreword is not part of ASME/ANSI B18.18.2M-1987.)

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 designation 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.



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

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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 Appendix II). To assist in arriving at the most appropriate inspection level, the Decision Table included in Appendix I is recommended for guidance.

### 1.3 Lot Sizes

When the acceptance number for sampling by attributes is fixed, variation in sample size results in variation of acceptable quality. Therefore, to avoid this inconsistency, fixed sample sizes are applied for the greatest range of lot size. Lot sizes are restricted to a maximum of 250,000 pieces.

### 1.4 Measuring and Testing Equipment

All measuring instruments, gages, and testing equipment used to inspect incoming materials and parts in process and in final inspection shall be calibrated at planned intervals to National Bureau of Standards (NBS) or other equivalent National Standards where applicable. The dates of calibration and fixture checks shall be recorded. Inspection records shall be kept for a minimum of 1 year.

### 1.5 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 Section 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 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.



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### 2.2 Applicable Characteristics

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 the Decision Table in Appendix I 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 Appendix II).

### 2.3 Lot Definition

A *lot* is a quantity of product of one part number made by the same production process and subsequently submitted for final inspection at one time. Maximum lot size traceable to final inspection shall be no larger than 250,000 pieces.

For lot sizes equal to or less than 5,000 pieces, sample size is reduced to maintain inspection at a practical level.

### 2.4 Records

The contractor shall maintain logs and records of inspections and tests as required by this plan. 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 year 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 other suppliers for use in the production of fasteners, provided the following conditions and requirements are met.

(*a*) The prime contractor shall be completely 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. The prime contractor shall include the requirements of this plan in the purchase order to the subcontractor.

(*c*) When the accessory, partially fabricated part, or treatment is processed by a subcontractor, the prime contractor shall so identify the subcontracting of the parts or processing in his records

(*d*) 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

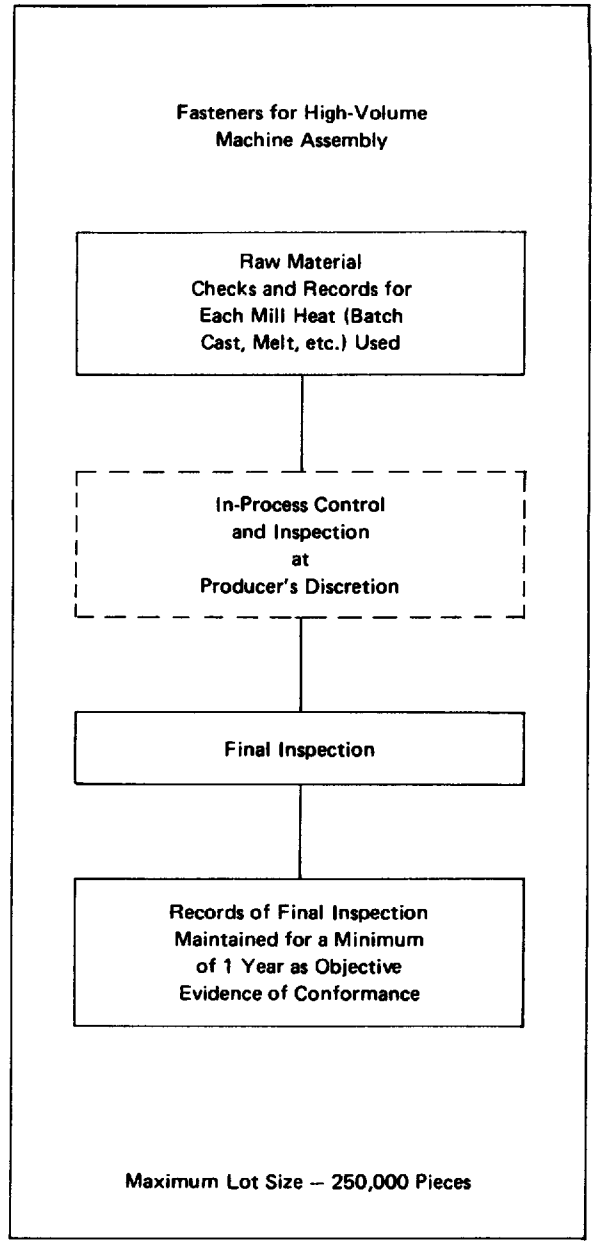


**FIG. 1 BASIC PLAN OUTLINE**



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finishing operations shall undergo final inspection by the prime contractor. Final inspection may be conducted by the subcontractor upon prior written approval of the customer.

### 2.6 Raw Material

**2.6.1 General.** Raw material 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. Raw material (rod, wire, or bar) 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 subject to a final inspection. The final inspection is intended to verify lot identification, to check for mechanical property conformance and mixed stock, and to inspect designated characteristics for conformance to related specifications and engineering drawings. Records of final inspection shall be maintained in accordance with para. 2.4. The nondestructive final inspection requirements are given in Table 1, and destructive test requirements are given in Table 2. Sample sizes are then determined in accordance with Table 3.

### 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 Nondestructive.** If a single nonconforming characteristic is found in final inspection, the lot may be resampled for this characteristic with a sample four times the size of the original final acceptance sample. The acceptance criterion will then be zero discrepancies in this larger sample.

**2.8.2.2 Destructive.** If a single nonconforming characteristic is found in final inspection, the lot may be resampled for this characteristic with a sample four times the size of the original final acceptance sample. The acceptance criterion will then be zero discrepancies in this larger sample.

**2.8.3 Customer Inspection.** If on receipt of the material the user discovers a single nonconforming part that functions defectively, he may sample the lot for such nonconforming characteristic(s) in accordance with para. 2.7, using an acceptance number of zero.

### 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 materials 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.



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**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.



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## 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 | Point diameter | B | NA | WA |
| 14 | Countersink diameter and depth | C | WA | WA |
| 15 | Thread acceptability [Note (1)] | B/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) Legend: WA — when applicable
NA — not applicable
(b) Refer to para. 2.8.2 for acceptance criteria. Refer to Table 3 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.



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## TABLE 2 FINAL INSPECTION — MACHINE ASSEMBLED AND OTHER SPECIAL PURPOSE FASTENERS — DESTRUCTIVE TESTS

| | Characteristic | Inspection Level | Internally Threaded Parts | Externally Threaded Parts |
|---|---|---|---|---|
| 1 | Proof load — externally threaded | C | NA | WA |
| 2 | Proof load — internally threaded | B | WA | NA |
| 3 | Tensile strength (wedge or axial) | B | NA | WA |
| 4 | Hardness [Note (1)] | A | WA | WA |
| 5 | Case depth | B | NA | WA |
| 6 | Decarburization | C | WA | WA |
| 7 | Torsional strength | B | NA | WA |
| 8 | Drive test | B | NA | WA |
| 9 | Prevailing torque [Note (2)] | B | WA | WA |
| 10 | Washer hardness | B | WA | WA |
| 11 | Ductility | A | WA | WA |
| 12 | Plating thickness | B | WA | WA |
| 13 | Salt spray [Note (3)] | B | WA | WA |
| 14 | Hydrogen embrittlement | A | WA | WA |

GENERAL NOTE:
*Legend:* WA — *when applicable*
NA — not applicable

NOTES:
(1) Surface, core, or both as appropriate.
(2) Prevailing torque test includes thread start, all specified torque requirements, and retention of locking feature, when applicable.
(3) Continuous monitoring of salt spray performance in accordance with the recommendation of Table B in Appendix I constitutes compliance with the requirements for salt spray testing outlined in this table. Refer to Table 3 for sample size.

## TABLE 3 SAMPLE SIZE — MACHINE ASSEMBLED AND OTHER SPECIAL PURPOSE FASTENERS

| Lot Size | Level of Inspection | Nondestructive Testing | Destructive Testing |
|---|---|---|---|
| 5,001–250,000 | A | 100 | 8 |
| | B | 32 | 4 |
| | C | 8 | 1 |
| 1,000–5,000 | A | 50 | 6 |
| | B | 16 | 3 |
| | C | 4 | 1 |
| Up to 1,000 (where sample size exceeds lot size, 100% inspection to be applied) | A | 25 | 4 |
| | B | 8 | 2 |
| | C | 2 | 1 |

GENERAL NOTE: Refer to para. 2.8.2 for acceptance criteria.



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# APPENDIX I

## TABLE A INSPECTION LEVEL DECISION TABLE

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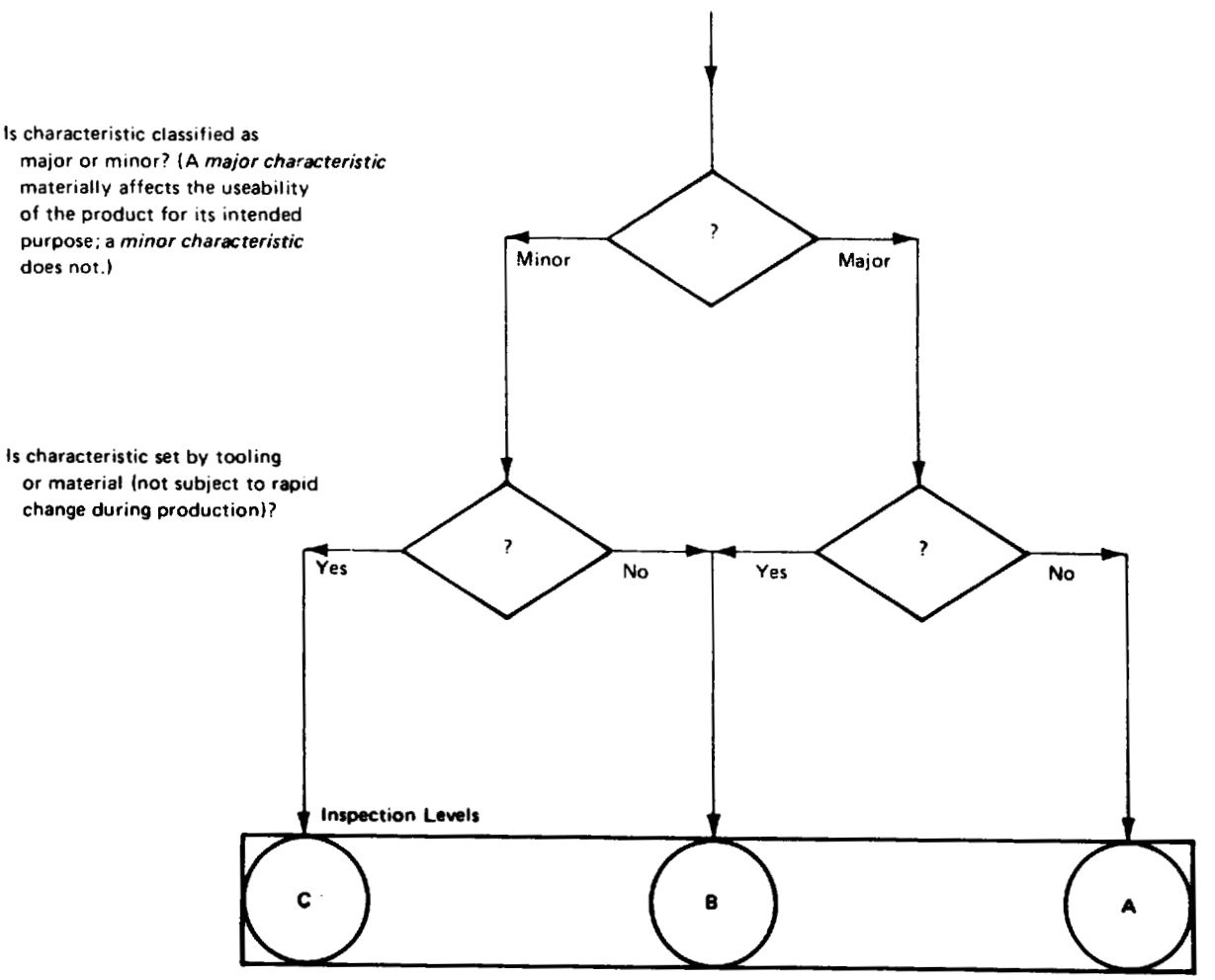




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## TABLE B SUGGESTED EQUIPMENT AND PROCESSING CONTROL CHECKS

| Finishing Operation | Control Check | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Analysis of Alkali Clean Tank — Log | Analysis of Acid Clean Tank — Log | Analysis of Cyanide Rinse — Log | Ratio of Soluble Oil to Water — Log | Analysis of Chromic Acid Rinse — Log | Analysis of Reverse Current Alkali Solution — Log | Plating Bath Analysis — Log | Analysis of Chromate Finish Solution — Log | Chemical Additives to All Solution Baths — Log | Filtering of Baths — Log | Check for Proper Elec. Contact — Log | Plating Bath Temperatures — Log | Clean Rinse Tanks — Log | Clean and Recharge All Process Tanks — Log | Time Interval Before Baking, Time and Temp. of Bake — Log | Analysis of Lubrication Bath — Log | Coating Weight and/or Thickness — Log | Salt Spray Test — Log |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| 1 Zinc electrodeposited plating | Daily | Daily | FSTDC | NA | NA | Daily | Daily | Daily | As added to each tank | FSTDC | Daily | Daily | FSTDC | As req'd based on analysis | WA each lot | NA | [Note (1)] | 2 pieces per line per shift |
| 2 Cadmium electrodeposited plating | Daily | Daily | FSTDC | NA | NA | NA | Daily | Daily | As added to each tank | FSTDC | Daily | Daily | FSTDC | 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 | FSTDC | Daily | Daily | FSTDC | 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 | FSTDC | Daily | Daily | FSTDC | 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 | FSTDC | Daily | Daily | FSTDC | 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 | FSTDC | 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:
Legend: WA — when applicable
NA — not applicable
FSTDC — 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.



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# APPENDIX II

# ORDERING INFORMATION

(This Appendix is not part of ASME/ANSI B18.18.2M-1987, and is included here for information purposes only.)

## Specifications

(*a*) Number and title of document
(*b*) Exceptions

## Example

(*a*) ASME/ANSI B18.18.2M, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

(*b*) Thread acceptability shall be based on the thread acceptability paragraph in ANSI/ASME B1.3M with an A inspection level.



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# AMERICAN NATIONAL STANDARDS FOR BOLTS, NUTS, RIVETS, SCREWS, WASHERS, AND SIMILAR FASTENERS


Small Solid Rivets . . . . . B18.1.1-1972 (R1983)
Large Rivets . . . . . B18.1.2-1972 (R1983)
Metric Small Solid Rivets . . . . . B18.1.3M-1983
Square and Hex Bolts and Screws — Inch Series . . . . . B18.2.1-1981
Square and Hex Nuts . . . . . B18.2.2-1972 (R1983)
Metric Hex Cap Screws . . . . . B18.2.3.1M-1979
Metric Formed Hex Screws . . . . . B18.2.3.2M-1979
Metric Heavy Hex Screws . . . . . B18.2.3.3M-1979
Metric Hex Flange Screws . . . . . B18.2.3.4M-1984
Metric Hex Bolts . . . . . B18.2.3.5M-1979
Metric Heavy Hex Bolts . . . . . B18.2.3.6M-1979
Metric Heavy Hex Structural Bolts . . . . . B18.2.3.7M-1979
Metric Hex Lag Screws . . . . . B18.2.3.8M-1981
Metric Heavy Hex Flange Screws . . . . . B18.2.3.9M-1984
Metric Hex Nuts, Style 1 . . . . . B18.2.4.1M-1979
Metric Hex Nuts, Style 2 . . . . . B18.2.4.2M-1979
Metric Slotted Hex Nuts . . . . . B18.2.4.3M-1979
Metric Hex Flange Nuts . . . . . B18.2.4.4M-1982
Metric Hex Jam Nuts . . . . . B18.2.4.5M-1979
Metric Heavy Hex Nuts . . . . . B18.2.4.6M-1979
Socket Cap, Shoulder and Set Screws (Inch Series) . . . . . B18.3-1986
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