

ASME B18.18-2017
(Revision of ASME B18.18-2011)

Quality Assurance for Fasteners

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AN AMERICAN NATIONAL STANDARD



The American Society of
Mechanical Engineers

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**The American Society of
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

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FOREWORD

This Standard is intended to be used as part of a contractual agreement between sellers and buyers of fasteners. It provides minimum criteria for four categories of metric and inch fasteners of any material type. It is to be used in concert with the specifications that apply to a given part. This Standard is intended to be a part within a larger quality assurance structure that addresses highly specific elements of quality planning, material control, human resources, gaging and testing, procedures, blueprint and standards control, and ongoing improvements that are necessary to permit the effective realization of the fastener itself. Such structures shall ideally be internationally recognized, but can be buyer specific.

This Standard also provides minimum criteria for manufacturing inspection and final inspection and allows for the necessary measure of flexibility and ingenuity of manufacturing approaches that suppliers may use as they comply with the standard's requirements and end objectives. It provides reference material to enable buyers and sellers to make modifications to their plans should they find that necessary in meeting the requirements of this Standard and those of their buyers.

In the implementation of this Standard, buyers must become cognizant of the source of supply manufacturing quality plan and use a means of their own to ensure that it is effective and that it is conscientiously and continuously being developed and improved. Nonconformity prevention and continuous improvement must be an ongoing cultural element that is applied by all members of the supply chain.

Historically, the fastener industry has been served by the standards ASME B18.18.1, B18.18.2, B18.18.3M, B18.18.4M, B18.18.5M, B18.18.6M, and B18.18.7M. These very standards have been replaced by this document but may still be referenced throughout the industry. The B18 Standards Committee and related Subcommittees are committed to replacing references to the aforementioned documents with a reference to this document.

This revision was undertaken based on feedback from fastener manufacturers. The main concern expressed was regarding the final inspection of Category 3 fasteners. It was never intended that in-process inspection completed by high quality fastener manufacturers would have to be duplicated by a laboratory. As more users requested Category 3 quality requirements, it became apparent that a revision was needed to clarify that fasteners supplied to Category 3 are manufactured by an ISO 9001 (or similarly recognized) registered factory, and that any necessary final inspection would be completed by an accredited test facility. The Nonmandatory Appendix regarding test report contents was removed because it had not been widely accepted. Other minor changes were made in the interests of clarity and conciseness.

This revision was approved by the American National Standards Institute on April 6, 2017.

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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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Two Park Avenue
New York, NY 10016-5990
<http://go.asme.org/Inquiry>

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.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the B18 Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B18 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at <http://go.asme.org/InterpretationRequest>. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the B18 Standards Committee at the above address. 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 in one or two words.
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. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. 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 the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

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QUALITY ASSURANCE FOR FASTENERS

1 GENERAL INFORMATION

1.1 Scope

This quality-focused Standard establishes in-process and final inspection requirements for fastener products as well as a receiving inspection plan for fastener purchasers. This Standard identifies four categories, recognizing that fastener users have widely varying requirements. The four categories covered are as follows:

(a) Category 1 — a receiving inspection plan for purchasers

(b) Categories 2 and 3 — utilizes documented and verifiable in-process controls structured at the producer's discretion

(c) Category 4 — includes all of the requirements of Category 2 plus 100% inspection for a specific feature or features

In the preparation of this Standard, it was recognized that its function must enable it to be a part of the various regimens in use today that attain certain quality levels of products. This Standard was written to encompass frameworks that enable the users of this Standard to pinpoint which category they wish to use in meeting their own objectives.

1.2 References

The following is a list of publications referenced in this Standard. Unless otherwise specified, the latest edition shall apply:

ASME B1.3M, Screw Thread Gaging Systems for Dimensional Acceptability — Inch Metric Screw Threads (UN, UNR, UNJ, M, and MJ)

ASME B18.6.3, Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)

ASME B18.12, Glossary of Terms for Mechanical Fasteners

Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

ASTM F1470, Standard Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

ASTM F1941, Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P. O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

ISO 9001, Quality management systems — Requirements

ISO/IEC 17011, Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories

ISO/TS 16949, Quality management systems — Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organizations

Publisher: International Organization for Standardization (ISO) Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

1.3 Measuring and Testing Equipment

All inspection and testing equipment that is used for the acceptance of Categories 2, 3, and 4 fasteners shall be calibrated by a laboratory that has been accredited to ISO/IEC 17025 by an accreditation body that operates in accordance with ISO/IEC 17011. Calibration may also be conducted by an organization authorized by the original equipment manufacturer. Calibration shall be traceable to the National Institute of Standards and Technology (NIST) Standard or an equivalent national or international standard.

1.4 Terminology

For definitions of terminology not specifically defined in this Standard, refer to ASME B18.12.

1.4.1 Lot. The definition of *lot* is provided in ASME B18.12. In the case of fastener assemblies, such as screw and washer assemblies, the manufacturer shall maintain lot traceability for all components. A finished fastener assembly lot shall comprise a single lot of each component that makes up the final assembly.

1.5 Designation of Final Inspection Category

Procurement documents should indicate which category (2, 3, or 4) of final inspection is required. Examples of designation are provided under the appropriate inspection category sections of this document.

2 BASIC PLAN REQUIREMENTS

2.1 Understanding the Basic Requirements

2.1.1 Sampling Acceptance Criterion. The acceptance criterion for final inspection is zero nonconformities ($C=0$) for all inspections. However, it should be

recognized that zero nonconformities ($C=0$) in a sampling plan does not mean that the population is entirely free of defects.

2.2 In-Process Inspection

2.2.1 Fabricating Operations. General inspection procedures shall be established on the basis of engineering and manufacturing experience with regard to the effort of setup, tooling, operator, machine setup, and operation on each characteristic at each processing station. The minimum in-process requirements at each machine or processing station shall be as follows:

(a) Five pieces shall be visually examined for gross defects and surface discontinuities as required by the applicable standards. Three pieces shall be verified for part characteristics imparted to it by that machine or processing station in accordance with Table 1 at the following times:

- (1) at the start of each production run
- (2) at the start of each new shift
- (3) when a tool is changed or when an adjustment in machine setup is made

(4) at the completion of each manufacturing operation

NOTE: When tungsten carbide dies are used, it is only necessary to verify a single piece for formed dimensions.

(b) During the production run, on a frequency of not less than one part per every 2 hr, parts shall be inspected for all designated part characteristics imparted to it by that machine or processing station in accordance with Table 1.

2.2.2 Heat Treatment. All heat-treating processes and heat-treatment equipment shall be regularly monitored to ensure process control and proper functioning of equipment. Monitoring equipment shall be calibrated by an accredited organization or an organization authorized by the original equipment manufacturer (see para. 1.3).

2.2.3 Finishing Operations. All plating, coating, and post lubrication processes and equipment shall be regularly monitored to ensure process control and proper functioning of equipment per applicable standards and specifications.

NOTE: Records of in-process inspections are not required for any category. If process records are maintained for Category 3 products, the lower final inspection sample sizes shown in Table 2 may be used instead of the sample sizes indicated in Table 3.

2.3 Final Inspection

Every lot of fasteners shall be subjected to a final inspection in accordance with the specified final inspection category. 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 point after which that characteristic will not be altered. Records of final inspection shall be maintained in accordance with para. 2.6.

2.4 Acceptance and Rejection

2.4.1 Raw Material. All raw material (rod, wire, bar, or sheet) shall meet the applicable requirements. Nonconforming raw materials shall not be used for the production of fasteners and shall be quarantined until disposition.

2.4.2 Manufactured Products. All parts shall conform to the applicable requirements during in-process inspection at all fabricating, heat treatment, or finishing operations. When nonconforming parts are found, all parts produced since the last inspection of the characteristic(s) found nonconforming shall be removed from further processing, quarantined, and held for disposition.

2.5 Disposition of Nonconforming Materials or Parts

2.5.1 Supplier's Options. The supplier has the choice of the following options in the disposition of nonconforming materials or parts:

- (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) They may be returned to the manufacturer if the supplier is not the manufacturer.
- (e) A request for deviation may be made to the end user.

If the end user 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 the deviation and release of the parts or materials for completion of production or for shipment as applicable.

NOTE: If the supplier is not the manufacturer, the supplier shall come to an agreement with the manufacturer if option (a) or (c) is selected by the supplier.

2.5.2 Purchaser's Options. The purchaser shall come to an agreement with the supplier on one of the following options for the disposition of nonconforming lots or parts that have been found after receipt:

- (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 purchaser considers that the degree to which the characteristic(s) vary from specified requirements will have no significant effect on the performance of the

parts in their service application, the purchaser may authorize release of the parts or materials for use and advise the supplier.

(e) They may all be returned.

2.5.3 Reinspection. All sorted and/or reworked parts shall be resubmitted for lot sampling and inspection for the characteristic(s) found to be nonconforming and all other characteristics that would be affected by the repair or reprocessing operation(s) at a sample size that is two times the size of the original. If no parts in the sample inspected are found to be nonconforming, the material may reenter the production flow or may be approved for delivery or use as applicable.

2.6 Records

The supplier shall maintain records of inspections and tests as required by this plan. The records shall include the nature and number of observations made, number and type of deficiencies found, quantities of conforming and nonconforming parts, and any corrective action taken including any dispositions made in accordance with para. 2.5. Records shall be maintained for a minimum of 5 yr from the date of inspection, unless otherwise agreed upon by the purchaser and the supplier. Copies of the records shall be provided to the purchaser when requested.

2.7 Applicable Characteristics

Attributes to be evaluated during final inspection are outlined in the appropriate category sections of this Standard (see Table 1 or 2 as applicable). Product standards that specify inspection attributes shall take precedence over those specified in this document. Product standards that dictate inspection attributes shall dictate all inspection attributes.

A purchaser may specify inspection attributes in purchase documents. Purchasers that dictate inspection attributes shall dictate all inspection attributes.

2.8 Alteration Services and Partially Fabricated Parts

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

(a) The fastener supplier shall be responsible to the purchaser for the quality of the final product.

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

(c) All lots that are processed by a subcontractor shall undergo inspection to determine if the parts conform to the requirements of the process and/or processes performed by the subcontractor.

3 CATEGORY 1 — OPTIONAL RECEIVING INSPECTION PLAN FOR PURCHASERS

3.1 Basic Category Structure

Category 1 is an optional receiving inspection plan for purchasers. This category utilizes a sampling plan that is not statistically based and focuses on attributes that affect form, fit, or function for the typical user. Purchasers may use this plan as a basis for determining product acceptability.

Receiving inspection is performed at the option of the purchaser. A purchaser may require a reseller to use this plan by specifying it as a requirement in the purchase agreement.

3.2 Designation

Designation of Category 1 on purchase documents is not required.

3.3 Lot Identification

Every effort should be made to maintain lot integrity. When lot identification is not provided for each container within a multiple container shipment of one item, the entire shipment may be handled as a single lot of fasteners when the sample sizes indicated in para. 3.4 are doubled.

3.4 Sample Size

A minimum of eight sample pieces, regardless of lot size, may be inspected for each applicable dimensional characteristic found in Table 4. For lots less than eight pieces, the entire lot may be inspected. The inspector may measure additional features that may be contained within individual fastener standards or purchaser drawings.

A minimum of two pieces may be inspected for each applicable mechanical property listed in Table 4.

4 CATEGORY 2 — FASTENERS INTENDED FOR GENERAL PURPOSE APPLICATIONS

4.1 Basic Category Structure

A Category 2 plan utilizes documented and verifiable in-process controls structured at the producer's discretion. Parts and documentation shall be in compliance with the requirements stated in this Standard and all supplemental requirements agreed upon between producer and purchaser. The producer shall provide evidence of the system structure upon request. Final inspection shall be performed by the producer with sample size dependent on lot size.

4.2 Designation

Category 2 should be designated on purchase documents by specifying "Quality Assurance Provisions per Category 2 of ASME B18.18 are required" or other equivalent statement. Category 2 shall be the default category

for fastener manufacturers in the absence of a specified category on purchasing documents.

4.3 Raw Material

4.3.1 Unless otherwise specified in the individual product standard, raw materials (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 specified material requirements.

4.4 Final Inspection and Test

Final inspection shall be completed by a person that has been properly trained and appointed by the producer. Minimum sample sizes shall be determined using Table 2. The attributes in Table 1 shall be inspected, unless otherwise specified by the purchaser or otherwise indicated in the product standard.

5 CATEGORY 3 — FASTENERS INTENDED FOR SPECIALIZED APPLICATIONS

5.1 Basic Category Structure

A Category 3 plan utilizes documented and verifiable in-process controls structured at the producer's discretion. Parts and documentation shall be in compliance with requirements stated in this Standard and all supplemental requirements agreed upon between producer and purchaser. The producer shall have an independently registered quality management system. Final inspection shall be performed by a facility accredited to the requirements of ISO/IEC 17025.

5.2 Designation

When required, Category 3 shall be designated on purchase documents by specifying "Quality Assurance Provisions per Category 3 of ASME B18.18 are required" or other equivalent statement. Absence of such statement will default seller to Category 2.

5.3 Quality Management System

Producers of Category 3 fasteners shall have an independently accredited quality management system that complies with the requirements of an internationally accepted standard such as ISO 9001 or ISO/TS 16949.

5.4 Raw Material

5.4.1 Raw materials (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.

5.5 Final Inspection and Test

Final inspection shall be performed by an ISO/IEC 17025 accredited laboratory. The sample sizes in Table 3 shall be used, unless the producer has in-process records (para. 2.2), in which case the sample sizes in Table 2 may be used.

Final inspection shall consist of the following:

- (a) verifying in-process inspection records for conformity
- (b) conducting any additional dimensional inspections to meet required sample size
- (c) conducting all applicable mechanical tests

5.6 Upgrade Option for Resellers

A reseller may, at its own discretion, use this process to upgrade existing inventory from Category 2 to Category 3.

5.6.1 Raw Material Certification. The reseller shall verify that the raw material meets the requirements of the applicable product and/or material standards. This may be performed by verifying the data on the original steel mill certificate or the material test report from the original fastener manufacturer.

5.6.2 Final Inspection for Upgrade. The reseller shall randomly select fasteners from a verifiable single lot and conduct the final inspection in a facility accredited to the requirements of ISO/IEC 17025 using the sample sizes in Table 3 and attributes listed in Table 1.

5.6.3 Records. The reseller shall attach the original Category 2 records to the newly created Category 3 records and maintain them according to para. 2.6.

6 CATEGORY 4 — AUTOMATED ASSEMBLY FASTENERS

6.1 Basic Category Structure

A Category 4 plan shall include all of the requirements of Category 2 plus a 100% sorting operation for a specific feature or features. Sorting is intended to remove the discoverable nonconforming parts from the lot being evaluated.

6.2 Designation

When required, Category 4 requirements shall be designated on purchase documents by specifying "Quality Assurance Provisions per Category 4 of ASME B18.18 are required" or other equivalent statement. Absence of such statement will default seller to Category 2. The purchaser shall specify which features require 100% sorting operation and an acceptable level of defects. Unless otherwise specified, the defect level shall be stated in parts per million (PPM).

EXAMPLE: ASME B18.6.3, $\frac{1}{4}$ -14 \times 1- $\frac{1}{4}$ Type AB, Type 1A Cross Recessed Pan Head Tapping Screw, Steel, Fe/Zn 3AN per

ASTM F1941. Quality Assurance Provisions per Category 4 of ASME B18.18 are required. Head height and head diameter shall be less than or equal to 50 PPM.

6.3 Hundred Percent Sorting Operation

Features requiring a 100% sorting operation shall be sorted by either manual or automated means. The sorting shall be performed by the supplier or a supplier designated subcontractor. The supplier is responsible for ensuring that the requested PPM is attained. Multiple 100% sorting cycles may be required to meet very low PPM levels.

Nonconforming pieces discovered during the sorting process shall be quarantined and disposed of in accordance with para. 2.5.1.

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Table 1 Categories 2, 3, and 4 Attributes

Attributes	Internally Threaded	Externally Threaded	Washers	Pins
Length				
Shank diameter (body or shoulder) [Note (1)]		C		C
Shank length (body or shoulder) [Note (1)]		B		B
Grip length, max. grip/min. body		B		C
Total thread length		B		
Concentricity of shank to thread or pitch diameter		C		
Length — overall		B		B
Heads/Nuts				
Width across flats	C	C		
Width across corners	C	C		
Head height or nut thickness or head thickness	C	C		C
Wrenching height	B	B		
Recess size (using gages)		C		
Recess depth (using gages)		B		
Head or nut diameter		B		
Flange or washer diameter	C	C		
Flange or washer thickness	C	C		
Flange flatness	C	C		
Head and/or flange location (position)	C	C		
Fillet radius		C		
Corner radius — square neck bolts		B		
Angles		C		
I.D. / O.D. eyebolts / lifting eyes		B		
Chamfer or radius, top or bottom of head or nut	C	C		
Bearing/Head to Shank/Runout/Protrusion				
Mandrel protrusion				C
Blind side protrusion				C
Mandrel diameter				C
Location between thread and shank		C		
Location between head and shank		C		C
Bearing surface diameter (washer face diameter)	C	C		
Bearing surface (washer face) thickness	C	C		
Location between thread and outside dimension for nuts (position of tapped hole)	B			

Table 1 Categories 2, 3, and 4 Attributes (Cont'd)

Attributes	Internally Threaded	Externally Threaded	Washers	Pins
Bearing/Head to Shank/Runout/Protrusion (Cont'd)				
Angularity of bearing surface	C	C		C
Diameter of undercut	C	C		
Depth of undercut	B	B		
Width of undercut	C	C		
Radius or fillet underhead		C		C
Underhead fillet transition diameter		B		
Underhead fillet transition length		B		
Shoulder chamfer		C		
Thread neck fillet		C		
Thread neck width		C		
Head countersunk angle		C		
Runout of the bearing surface with respect to the shank or runout of the bearing surface with respect to the thread		C	C	
Head protrusion/flushness		B		
Washer: runout of I.D. to O.D. of washers			C	
Point				
Point diameter		C		C
Point length		C		
Dog point diameter		B		
Dog point length		B		
Dog point concentricity		C		
Oval point radius		B		
Angles — all points — all set screw configurations		C		
Corner radius		C		
Recess/Drive/Cross Drill				
Recess or socket depth penetration		B		
Recess depth		B		
Angle, bottom of socket		C		
Wall thickness		C		
Location of recess		C		
Location of hole or socket		C		
Socket or hole size		B		
Countersink diameter and depth		C		
Angularity of tapping by tapping screws		C		

Table 1 Categories 2, 3, and 4 Attributes (Cont'd)

Attributes	Internally Threaded	Externally Threaded	Washers	Pins
Recess/Drive/Cross Drill (Cont'd)				
Slot width		C		
Slot depth		B		
Slot alignment and location		B		
Cross drilled holes — location		B		
Cross drilled holes — diameter		B		
Cross drilled holes — chamfers or burrs		B		
Cross drilled holes — hole alignment		B		
Washers — Including Washers for Assembly (SEMs)				
Type of washer(s)			C	
Washer outside diameter			C	
Washer inside diameter			C	
Washer thickness			C	
Washer flatness			C	
Bearing width			C	
Section width			C	
Other				
Thread acceptability [Note (2)]	B	B		
Visual inspection [Note (3)]	A	A		
Straightness		C		C
Thread dimensions for nonscrew threads		B		
Body diameter		C		
Outside diameter — dowel pins and shoulder bolts	A			

GENERAL NOTE: A, B, and C are representative of the sample sizes in Tables 2 and 3.

NOTES:

- (1) The term *shank* includes body diameter, shoulder diameter, and any length of unthreaded cylinder whose diameter is approximately pitch diameter.
- (2) Thread acceptability is determined in accordance with ASME B1.3M.
- (3) Visual inspection for presence of plating, duds, surface discontinuities, head style, type of recess, type of nut and washer, presence of locking feature, finish, and general workmanship. Those characteristics previously subjected to inspection do not require reinspection.