ASME B18.18.5M-1998

INSPECTION AND QUALITY ASSURANCE PLAN REQUIRING IN-PROCESS INSPECTION AND CONTROLS

AN AMERICAN NATIONAL STANDARD

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Date of Issuance: July 22, 1998

This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

FOREWORD

(This Foreword is not part of ASME B18.18.5M-1998.)

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 documents 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 documents should be circulated for subcommittee consideration as proposed standards. Subcommittee acceptance of the content ensued and the documents were approved by letter ballot to the American National Standards Committee B18 on March 21, 1980.

The standards were subsequently approved by the Secretariat and submitted to the American National Standards Institute for designation as an American National Standard; they were designated ANSI B18.18.1M-1982, B18.18.2M-1982, B18.18.3M-1982 and B18.18.4M-1982 and approved on September 14, 1982.

A periodic review of the standards, undertaken by the subcommittee in 1985, resulted in agreement that the documents be revised to allow them to be used for inch as well as metric products. This was done by deleting the word "metric" from the titles as well as from each place in the standards where it would inhibit the use of the documents for inch as well as metric products. By retaining the "M" in the designator, the standards 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.

On November 16, 1990, the Fastener Quality Act (P.L. 101–592) was signed into law. The focus of the law is to assure the user that certain fasteners conform to the specification to which they were made through inspection and testing by accredited laboratories.

The law stresses the relationship of the product to its standard. Based on the implementation of the law, product standards were revised to incorporate sample plans and quality system guidelines to facilitate inspection and testing. All quality system standards in the B18.18 series incorporate a final inspection in addition to in-process inspection and testing. A review of various manufacturer's quality strategies indicated the need for an in-process quality plan that did not require final inspection and testing. To address that need, the plan defined in ASME/ANSI B18.18.3M-1987 was modified and brought before Subcommittee 18 of Committee B18 at the December 1996 meeting for review and circulation.

ASME B18.18.5M-1998 was approved as an American National Standard on January 6, 1998.

ASME B18 STANDARDS COMMITTEE
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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CORRESPONDENCE WITH B18 COMMITTEE

General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending committee meetings. Correspondence should be addressed to: Secretary, B18 Main Committee, The American Society of Mechanical Engineers, Three Park Avenue, New York, New York 10016-5990.

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes which 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.

Interpretations. On request, the B18 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 Main Committee.

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

Subject: Cite the applicable paragraph number(s) and a concise description.

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 which are necessary to explain the question; however, they should not contain proprietary names or information.

Requests which are not in this format will be rewritten in this 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 which 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.

Attending Committee Meetings. The B18 Main Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B18 Main Committee.

CONTENTS

INSPECTION AND QUALITY ASSURANCE PLAN REQUIRING IN-PROCESS INSPECTION AND CONTROLS

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. The basic structure of this plan outlines the quality assurance provisions for fasteners manufactured and processed using in-process controls. Included are fasteners produced by one manufacturing practice requiring records of in-process inspection and tests which are maintained by the producer.

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 the subjecting of all characteristics to the same degree of inspection impractical. Therefore, four 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, related standards, and/or 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 and test incoming materials and parts in process shall be permanently marked with a unique identification number. This equipment shall be inspected and calibrated at planned intervals to National Institute of Standards and Technology (NIST) standards, or other equivalent national standards where applicable. The dates of calibration shall be recorded. Inspection records shall be kept for a minimum of five years.

1.5 Basic Plan Outline

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

2 DESCRIPTION OF PLAN

2.1 Scope

This plan is based on the concept of quality assurance through in-process control. It establishes specific inspection functions that must be performed during each process and at each operation involving the production of fasteners, with the objective of producing finished fasteners that shall conform to all customer requirements as specified in engineering drawings, related standards, and/or specifications.

The in-process inspection and testing functions specified in engineering drawings, related standards, and/or specifications shall be conducted by the person(s) having direct responsibility for conducting or monitoring the operation or process which generates the characteristic(s).

The general plan presents a uniform control procedure that is intended to be applicable to all important characteristics used in the manufacture of fasteners. Adherence to the characteristic requirements of this plan does not release the contractor from the responsibility of exercising due care in the production of all parts to ensure that the requirements established for all characteristics shown on engineering drawings and related specifications have been met. This plan requires

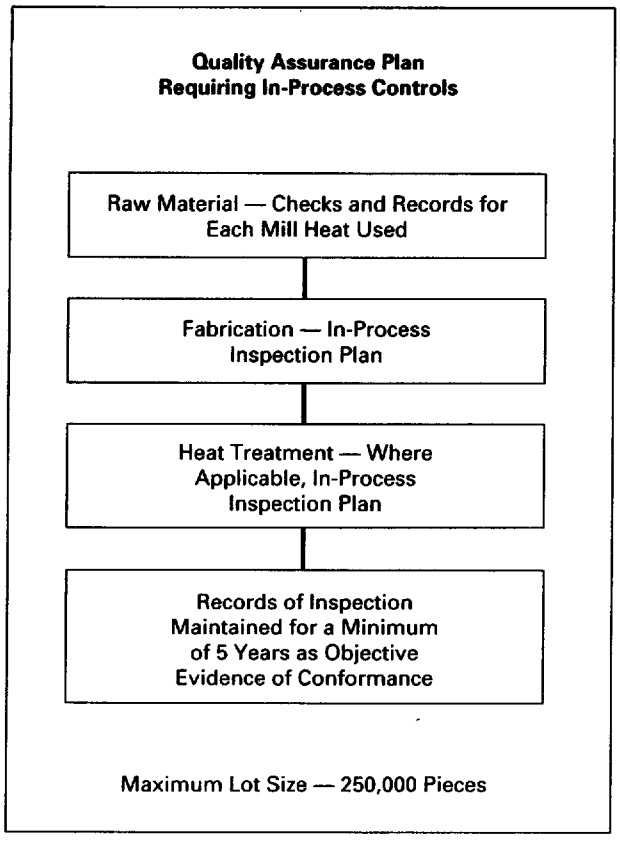


FIG. 1 BASIC PLAN OUTLINE

that records of inspection and tests be maintained as objective evidence of conformance to the plan.

2.2 Applicable Characteristics

Applicable characteristics include all characteristics of a part that are described by engineering drawings, related standards, and/or specifications (see Tables 5 and 6). Applicable characteristics also include those transitional characteristics of a part that are present in some intermediate stage in the manufacture of the part (see Tables 1 and 2). As-quenched hardness is an example of a transitional characteristic. Four levels of inspection — A, B, C, and D — are provided in the plan. Each characteristic has been assigned an appropriate level.

Any additional characteristics deemed applicable by the user and not appearing in the general plan, or characteristics for which the user requires a nonstandard inspection level, shall be designated by the user, preferably on engineering drawings, related standards, and/or specifications, by the appropriate code letter at the time of inquiry and ordering. Refer to the Decision Table in Appendix I for guidance in establishing these nonstandard levels.

2.3 Lot Definition

A *lot* is a quantity of fasteners of one part number fabricated by the same production process from the same coil or heat number of metal as provided by the metal manufacturer and submitted for inspection and testing at one time.

The maximum lot size shall be no larger than 250,000 pieces.

Where order size and material quantity is sufficient to create more than 250,000 pieces of the same part number, a new lot shall be created for each 250,000 pieces of product manufactured.

Lot purity, lot identity, and lot traceability shall be maintained from raw material through all operations to packing and shipping.

2.4 Records

The manufacturer 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 and shall be maintained for a minimum of 5 years from the date of shipment of the part as objective evidence of conformance to the provisions of this plan.

2.5 Purchased Accessories and Parts

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

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

(b) The subcontractor shall provide evidence to the manufacturer that systems are in place to support all inspection and tests specified in engineering drawings, related standards, and/or specifications.

(c) When the accessory, partially fabricated part, or treatment is processed by a subcontractor, the manufacturer shall so identify the subcontractor(s) of the parts and designate the process performed 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 finishing operations shall undergo inspection by the manufacturer. Final inspection may be conducted by the subcontractor upon prior written approval of the customer.

2.6 Certification

2.6.1 When required, the manufacturer shall be capable of issuing a test report containing actual data acquired during in-process inspection and testing.

When applicable, test results generated by the subcontractor shall be included as part of the manufacturer's certified test report.

2.7 Raw Material

2.7.1 General. Raw material shall be reviewed to determine that each coil or bundle has a mill identification and that each heat (batch, cast, melt, 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.

2.7.2 Material Specifications. Each heat (batch, cast, melt, etc.) of steel used to produce heat treated parts shall have its suitability verified by chemical analysis or hardenability.

2.7.3 General Quality. During manufacturing, fasteners shall be visually inspected on a continuing basis to verify the quality of the raw material and its condition. The parts shall be examined for evidence of pipe, seam, cracks, bursts, and other surface discontinuities according to applicable specifications.

2.8 In-Process Inspection

At each machine or processing station, the part shall be checked during production for designated characteristics imparted to it by that machine or processing station. Since it is not essential that destructive tests be conducted at the time test samples are selected, the producer may elect to accumulate test samples taken in process for testing at one time. This provides uniform sampling as intended by in-process inspection.

2.8.1 Fabricating Operations. Table 1 lists most dimensional and geometric characteristics of fasteners covered in this plan with designated inspection levels. These general inspection procedures have been established on the basis of engineering and manufacturing experience with regard to the effect of raw material, setup, tooling, operator, and machine operation on each characteristic at each processing station.

The minimum in-process requirements at each machine or processing station shall be as follows.

(a) At the start of each production run, five pieces of the part shall be sampled and then checked in accordance with Table 4 for all designated characteristics imparted to it by that machine or processing station.

(b) At the start of each new shift, five pieces of the part shall be sampled and then checked in accordance with Table 4 for all designated characteristics imparted to it by that particular machine or processing station.

(c) When a tool is changed or when an adjustment in machine setup is made, five pieces of the part shall be sampled and then checked in accordance with Table 4 for all designated characteristics affected by the new tool or by the setup adjustment.

(d) During the production run, the part shall be checked for all designated characteristics imparted to it by that machine or processing station in accordance with Tables 1 and 2 for nondestructive and destructive testing, respectively. The frequency shall be determined in accordance with para. 2.8.2.

(e) At the completion of each production run, the last piece shall be completely checked for all characteristics imparted to it by that machine or processing station.

(f) Records shall be maintained in accordance with para. 2.4.

2.8.2 In-Process Controls. The inspection level shall be in accordance with Tables 1 and 2 for nondestructive and destructive testing, respectively. The frequency of sampling for testing associated with each code letter may be determined from the nomograph of Fig. 2 and is a function of production rate and lot size. Frequency of destructive testing is contained in Table 3.

When the frequency of sampling is less than one piece per hour, the time interval between sampling shall be evenly spaced throughout the shift to the degree practicable.

Checks made at the start of the shift or the production run, or following tool change or machine adjustment, may contribute to the specified checks under para. 2.8.1(d) within the following hour only.

Visual examination of general workmanship shall include inspection for surface discontinuities, legibility of identification markings, duds, and general appearance.

2.8.3 Heat Treatment

(a) Process and Equipment. All heat treating processes (including stress relief) and heat treatment equip-

TABLE 1 IN PROCESS — NONDESTRUCTIVE

	Characteristic	Inspection level	Internally Threaded Parts	Externally Threaded Parts
	Forming Process			
1	Shank diameter (body or shoulder)	C	WA	WA
2	Length	B	WA	WA
3	Width across flats	B	WA	WA
4	Width across corners	C	WA	WA
5	Shoulder or body length	B	NA	WA
6	Width of undercut	C	NA	WA
7	Dog point length	C	NA	WA
8	Head height or nut thickness	C	WA	WA
9	Wrenching height	C	WA	WA
10	Angularity of bearing surface	C	NA	WA
11	Bearing surface diameter	D	WA	WA
12	Flat head countersunk angle	C	NA	WA
13	Flat head axis of the conical bearing surface/parallel to the axis of the body	C	NA	WA
14	Shoulder chamfer	B	NA	WA
15	Thread neck fillet	B	NA	WA
16	Head diameter	C	NA	WA
17	Flange diameter	C	WA	WA
18	Flange thickness	C	WA	WA
19	Recess or socket depth penetration	B	NA	WA
20	Flat head protrusion/flushness	A	NA	WA
21	Point diameter	C	NA	WA
22	Countersink diameter and depth	D	WA	NA
23	Grade and source	D	WA	WA
24	Head and/or flange concentricity	C	WA	WA
25	Angle, bottom of socket	D	NA	WA
26	Oval point radius	C	NA	WA
27	Dog point diameter	C	NA	WA
28	Flange flatness	C	WA	WA
29	Radius or fillet under head	D	WA	WA
30	Diameter of undercut	B	NA	WA
31	Depth of undercut	D	NA	WA
32	Chamfer or radius, top or bottom of head	A	NA	WA
33	Wall thickness	B	NA	WA
34	Under head fillet transition diameter	B	NA	WA
35	Under head fillet transition length	B	NA	WA
36	Angles — all points — all set screw configurations	C	NA	WA
37	Eccentricity of recess	C	NA	WA
38	Concentricity of hole or socket	C	WA	NA
39	Visual inspection [Note (1)]	A	WA	WA
40	Thread acceptability [Note (2)]	B/C/D	WA	WA
41	Socket or hole size	A	NA	WA
42	Concentricity of head and shank (or shoulder)	B	NA	WA
43	Dog point concentricity	C	NA	WA
44	Total thread length	B	NA	WA
45	Grip length	B	NA	WA
46	Angularity of tapping	C	WA	NA
47	Visual inspection [Note (1)]	A	WA	WA
48	Concentricity of body (or shoulder) to thread (or pitch diameter)	B	NA	WA
49	Total runout between thread, body and head	C	NA	WA

TABLE 1 IN PROCESS — NONDESTRUCTIVE (CONT'D)

	Characteristic	Inspection level	Internally Threaded Parts	Externally Threaded Parts
	Slotting			
50	Slot width	C	WA	WA
51	Slot depth	B	WA	WA
52	Slot alignments and location	C	WA	WA
53	Visual inspection [Note (1)]	A	WA	WA
	Drilling			
54	Cross drilled holes — location	C	NA	WA
55	Cross drilled holes — diameter	B	NA	WA
56	Cross drilled holes — chamfers or burrs	C	NA	WA
57	Cross driled holes — hole alignment	B	NA	WA
	Prevailing Torque Feature			
58	Width across flats	C	WA	NA
59	Thread start	A	WA	WA
60	Visual inspection [Note (1)]	A	WA	WA
	Washer for Assemblies			
61	Type of washers	D	WA	WA
62	Washer O.D.	D	WA	WA
63	Washer I.D.	D	WA	WA
64	Washer thickness	D	WA	WA
65	Visual inspection [Note (1)]	A	WA	WA

GENERAL NOTES:
(a) Legend: WA — when applicable
NA — not applicable
(b) Refer to para. 2.9.2 for acceptance criteria. Refer to Fig. 2 for frequency testing.

NOTES:
(1) 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.
(2) ASME B1.3M or other applicable standards and at the appropriate inspection level (B, C, or D).

ment shall be regularly monitored to ensure process control and proper functioning of equipment. Suggested furnace and processing control checks and the frequency at which they should be made and recorded are included in Table B in Appendix I.

(b) Testing of Heat Treated Fasteners. Heat treated fasteners are fasteners that have been subjected to one or more heat treatment operations. Heat treated fasteners shall be tested after all intermediate and final heat treatment stages. The characteristics of the various types of fasteners and the minimum frequency of their inspection are detailed in Tables 2 and 3.

(c) Records. Records shall be maintained in accordance with para. 2.4.

2.8.4 Finishing Operations

(a) Processing and Equipment. All plating, coating, and postlubrication processes and equipment shall be regularly monitored to ensure process control and proper functioning of equipment. Suggested process control checks and the frequency with which they should be made and recorded are included in Table C in Appendix I.

(b) Inspection of Finished Fasteners. Plating thickness and/or coating weight, thread fit, general appearance, and, where applicable, corrosion resistance of plated or coated fasteners shall be checked and recorded in accordance with Tables 3 and 6.

(c) Performance Testing. Fasteners having unique performance characteristics such as torque-tension, tension-indication, or locking elements may be performance tested in accordance with the requirements specified in Tables 5, 6, and 7 covering receiving inspection, nondestructive and destructive. All test results shall be recorded.

TABLE 2 IN PROCESS — DESTRUCTIVE

Characteristic	Description of Control: Inspection Level	Internally Threaded Parts	Externally Threaded Parts	Heat Treated Parts
Tensile strength (wedge or axial)	C	NA	WA	WA
As-quenched hardness center [Note (1)]	B	WA	WA	WA
Hardness [Note (2)]	A	WA	WA	WA
Case depth	B	NA	WA	WA
Decarburization	C	WA	WA	WA
Torsional strength	B	NA	WA	WA
Washer hardness	B	NA	WA	WA
Plating thickness	C	WA	WA	WA
Corrosion resistance [Notes (3), (4)]	C	WA	WA	WA
Hydrogen embrittlement [Note (5)]		WA	WA	WA

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

NOTES:
(1) As-quenched hardness is checked following heating and quenching prior to tempering.
(2) Surface, core, or both, as applicable.
(3) Continuous monitoring of salt spray performance in accordance with the recommendation of Table C in Appendix I constitutes compliance with the requirements for salt spray testing outlined in this table.
(4) Includes salt spray and other corrosion resistance tests.
(5) Refer to the specific product or process standard for hydrogen embrittlement test requirements and sample size.

2.9 Acceptance and Rejection

2.9.1 Basis of Rejection. Any coil of rod or wire or bundle of bars failing to meet the requirements of para. 2.7 shall be held for disposition.

If any parts are found to be nonconforming during any in-process inspection at any fabricating, heat treatment, or finishing operation, all parts produced since the last inspection of the characteristic(s) found nonconforming shall be removed from further processing and held for disposition.

2.9.2 Acceptance Criteria

2.9.2.1 Nondestructive and Destructive. If during in-process inspection and testing, a single nonconforming characteristic is found, all material produced since the last inspection of that characteristic shall be put on hold and removed from the production flow.

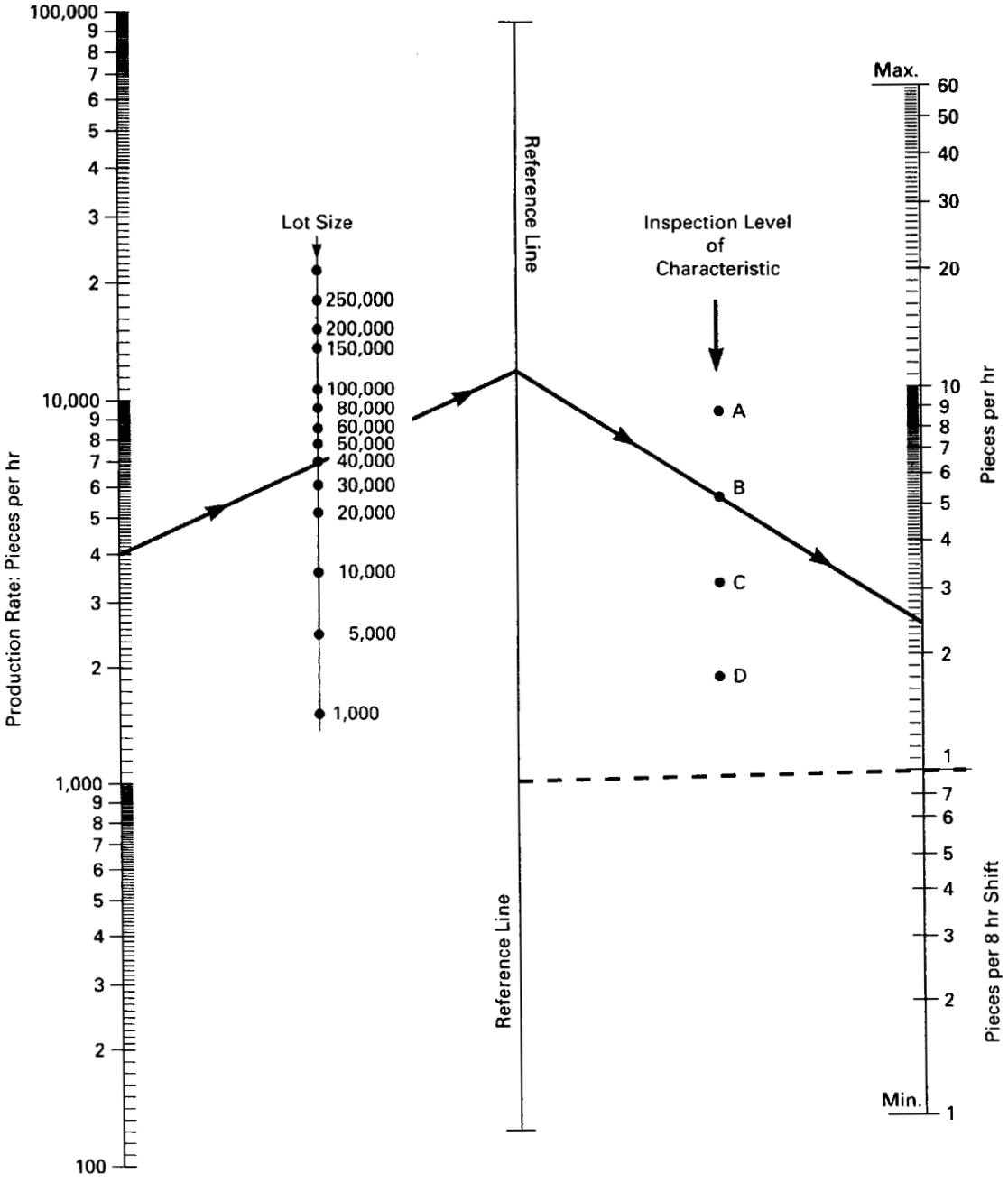
2.9.2.2 Following removal of the nonconforming material from the product flow, the process shall be adjusted to produce conforming parts. Parts shall then be inspected in accordance with para. 2.8.1(c).

2.9.2.3 The material on hold may then be resampled for the nonconforming characteristic(s) with a sample four times the size of the receiving inspection sample size given in Table 7, according to the requirements of Tables 5 and 6 for receiving inspection nondestructive and destructive, respectively. The acceptance criterion will be zero discrepancies in this larger sample. Material still found to be nonconforming shall be dispositioned in accordance with para. 2.10.1.

2.9.3 Customer Inspection. Each lot of fasteners may be subjected to a receiving inspection by the user. The receiving inspection may be used to verify that the lot consists of the ordered parts and to inspect or test certain characteristics that may be critical to the performance of the parts in their service application. When used, such inspections or tests may be conducted in accordance with the requirements stated in Tables 5, 6, and 7 covering receiving inspection, nondestructive and destructive.

2.10 Disposition of Nonconforming Materials or Parts

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



GENERAL NOTE:
USE: Starting at left-hand axis of production rate, set rate of operation and from this point, draw a straight line through corresponding lot size to the reference line. From the reference point, draw a straight line through point for required inspection level and extend to right-hand axis of sampling frequency.

EXAMPLE: For production rate of 4,000 pcs/hr lot size 40,000 Level B, required sampling frequency = 3 pcs/hr.

FIG. 2 IN-PROCESS SAMPLING FREQUENCY (NONDESTRUCTIVE)

TABLE 3 FREQUENCY OF DESTRUCTIVE TESTING

Inspection level	Continuous Equipment 3 at Start of Run +	Batch Equipment
A	3 per hour	3 per batch
B	1 per hour	1 per batch
C	1 per 4 hour per lot	1 per batch
D	1 per lot	1 per batch

TABLE 4 IN-PROCESS TESTING FREQUENCY AT SETUP, SHIFT CHANGE, AND AFTER MACHINE ADJUSTMENTS

Level of Characteristics	Number of Checks
A	5
B	3
C	2
D	1

2.10.1 Manufacturer's Options. The manufacturer has the choice of the following options in the disposition of those parts that have been found to be nonconforming 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.

(e) Parts or material may be used for another application.

2.10.2 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 found to be nonconforming after receipt from the manufacturer.

(a) They may be scrapped.

(b) They may be 100% sorted and all defective 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.

2.10.3 Shipping Authorization. Authorization to ship parts containing nonconforming characteristic(s) shall be in writing. This authorization shall include purchase order number, part description, drawing number and revision level part number, lot size, nature of nonconforming characteristic(s), and number of parts having the nonconforming condition(s).

When required by the user, the manufacturer shall be capable of clearly identifying all cartons containing nonconforming material.

2.11 Reinspection

All pieces which have been sorted and/or reworked in accordance with para. 2.10.1 or 2.10.2 shall be resubmitted for lot sampling and inspection of the characteristic(s) found nonconforming and all other characteristics that would be affected by the repair or reprocessing operation(s) at an inspection level four times the size of the original final acceptance sample.

If no parts in the sample inspected are found defective, the material may reenter the production flow or may be approved for delivery or use, as applicable.

2.12 Corrective Action

When required by the user, the manufacturer shall be capable of determining the root cause(s) of any nonconforming condition and informing the user in writing what action will be taken to assure the cause of the nonconformance will be corrected.

TABLE 5 RECEIVING INSPECTION — NONDESTRUCTIVE

Characteristics	Description of Control		
	Inspection Level	Internally Threaded Parts	Externally Threaded Parts
Body or shoulder diameter	C	NA	WA
Length	B	NA	WA
Width across flats	B	WA	WA
Wrench height, min.	D	WA	WA
Head height or nut thickness	B	WA	WA
Head diameter	B	NA	WA
Head style	D	NA	WA
Angularity of bearing surface	A	WA	WA
Flange diameter	C	WA	WA
Thread acceptability [Note (1)]	B/C/D	WA	WA
Flange dimensions	D	WA	WA
Presence of locking feature	A	WA	WA
Visual inspection [Note (2)]	A	WA	WA

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

NOTES:

(1) ASME B1.3M or other applicable standards and at the inspection level (B, C, or D).

(2) Visual inspection for grade and source identification, presence of finish, duds, surface discontinuities, type of recess or socket, type of washer, type of nut, finish, radius or fillet under head, thread chamfer, cleanliness, lubrication, and general workmanship. Refer to Table 7 for sample size.

TABLE 6 RECEIVING INSPECTION — DESTRUCTIVE

Characteristics	Description of Control: Inspection Level	Internally Threaded Parts	Externally Threaded Parts
Proof load — externally threaded	D	NA	WA
Proof load — internally threaded	B	WA	NA
Tensile strength (wedge or axial)	C	NA	WA
Hardness [Note (1)]	B	WA	WA
Washer hardness	B	WA	NA
Drive test	B	NA	WA
Prevailing torque [Note (2)]	A	WA	WA
Torque-tension	A	WA	WA
Ductility	B	WA	WA
Plating thickness	B	WA	WA
Salt spray	B	WA	WA

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

NOTES:

(1) Surface, core, or both, as applicable.

(2) Prevailing torque test includes thread start, all specified torque requirements, and retention, of locking feature, when applicable. Refer to Table 7 for sample size.

TABLE 7 RECEIVING INSPECTION — SAMPLE SIZE

Inspection Level	Nondestructive Tests [Note (1)]	Destructive Tests
A	25	8
B	9	4
C	3	2
D	1	1

GENERAL NOTE:
Quench cracking observed in a single piece renders the lot subject to rejection.

NOTE:

(1) When sample size exceeds lot size, 100% inspection is to be applied.

APPENDIX I
TABLES A, B, AND C

(This Appendix is not part of ASME B18.18.5M-1998 and is included for informational purposes only.)

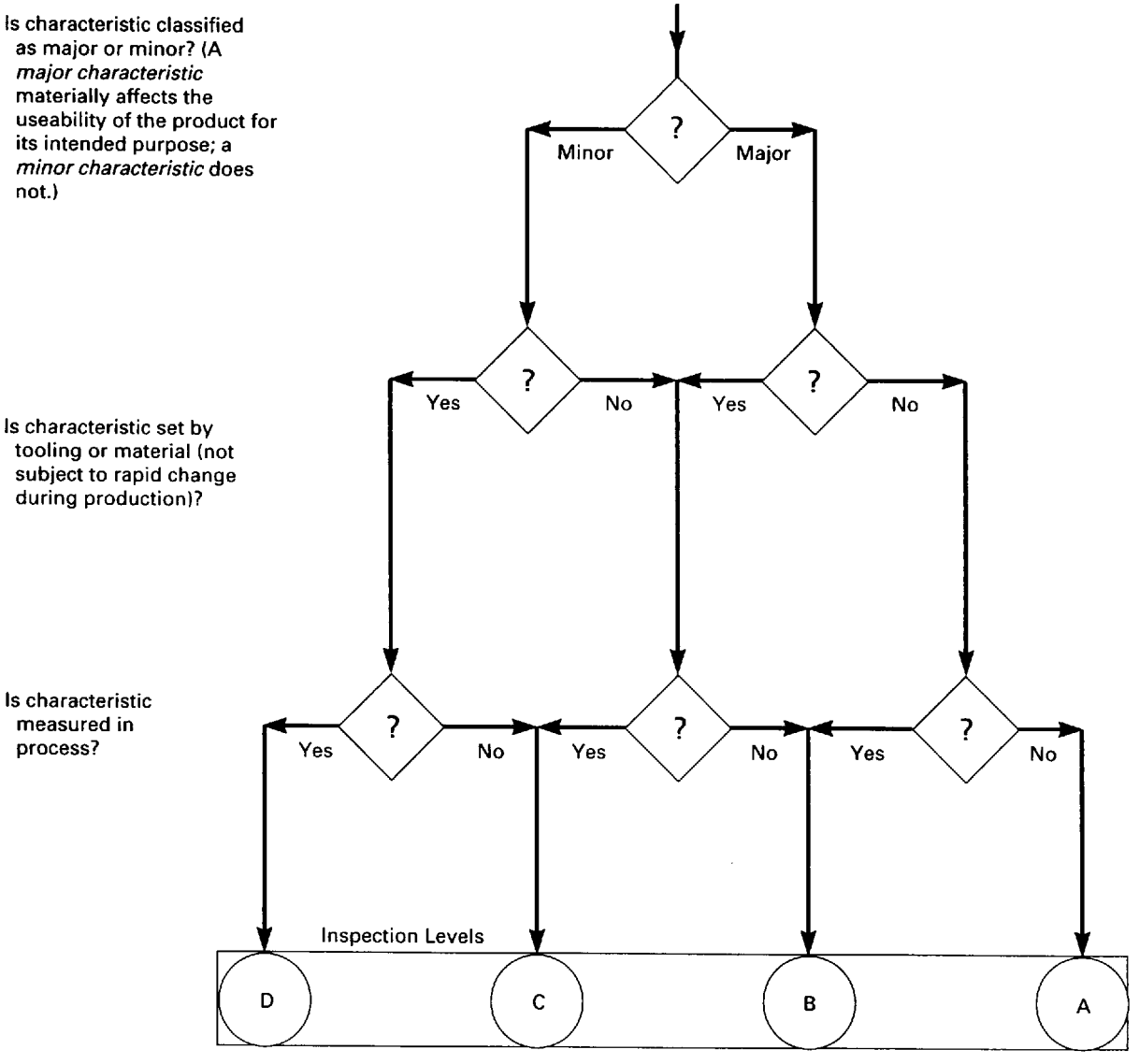


TABLE A INSPECTION LEVEL DECISION TABLE

TABLE B SUGGESTED EQUIPMENT AND PROCESSING CONTROL CHECKS

Heat Treatment Process	Control Check															
	Check Indicated Temperature — Log	Check Dew Point, CO_2 or CH_4 — Log	Check Atmosphere Gas Flows — Log	Standardize Temperature Control Instrumentation — Log	Calibrate Thermocouple Change as Required — Log	Atmosphere Purging Req'd When Process Gas Changed	Carbon Potential Check — Log	Check Furnace Pressure, Air or Gas Leaks, Radiant Tubes, etc. — Log	Check Condition of Quench Oil — Log	Check Air/Gas Ratio, Refrig. Temp., Cooling Water Temp., and Pressures — Log	Analysis of Gas Atmosphere — Log	Check Time in Continuous-Type Furnace — Log	Check Time at Heat in Batch-Type Furnace — Log	Temperature of Quench Medium — Log	Quench Medium Circulation — Log	Visual Check of Furnace Loading — Log
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Hardening furnace atmosphere quench — continuous	Each lot	4 hr [Note (1)]	Each lot	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	FSTDC	NA	NA (refer to col. 2)	Each lot	NA	Each lot	Start of each shift	FSTDC
Hardening furnace atmosphere quench — batch type	Each batch	Each batch or 4 hr [Note (1)]	Each batch	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	FSTDC	NA	NA (refer to col. 2)	NA	NA (refer to col. 1)	Each batch	Each batch	FSTDC
Carburizing furnace quench — continuous	Each lot	4 hr [Note (1)]	Each lot	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	FSTDC	NA	NA (refer to col. 2)	Each lot	NA	Each lot	Start of each shift	FSTDC
Carburizing furnace quench — batch type	Each batch	Each batch or 4 hr [Note (1)]	Each batch	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	FSTDC	NA	NA (refer to col. 2)	NA	NA (refer to col. 1)	Each batch	Each batch	FSTDC
Carbonitriding furnace quench — continuous	Each lot	4 hr [Note (1)]	Each lot	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	FSTDC	NA	NA (refer to col. 2)	Each lot	NA	Each lot	Start of each shift	FSTDC
Carbonitriding furnace quench — batch type	Each batch	Each batch or 4 hr [Note (1)]	Each batch	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	FSTDC	NA	NA (refer to col. 2)	NA	NA (refer to col. 1)	Each batch	Each batch	FSTDC
Annealing furnace atmosphere — continuous	Each lot	4 hr [Note (1)]	Each lot	Daily	Monthly	[Note (2)]	FSTDC	6 months max. and as req'd	NA	4 hr	FSTDC	Each lot	NA	NA	NA	FSTDC

TABLE B SUGGESTED EQUIPMENT AND PROCESSING CONTROL CHECKS (CONT'D)

Heat Treatment Process	Control Check: Check Indicated Temperature — Log	Check Dew Point, CO_2 or CH_4 — Log	Check Atmosphere Gas Flows — Log	Standardize Temperature Control Instrumentation — Log	Calibrate Thermocouple Change as Required — Log	Atmosphere Purging Req'd When Process Gas Changed	Carbon Potential Check — Log	Check Furnace Pressure, Air or Gas Leaks, Radiant Tubes, etc. — Log	Check Condition of Quench Oil — Log	Check Air/Gas Ratio, Refrig. Temp., Cooling Water Temp., and Pressures — Log	Analysis of Gas Atmosphere — Log	Check Time in Continuous-Type Furnace — Log	Check Time at Heat in Batch-Type Furnace — Log	Temperature of Quench Medium — Log	Quench Medium Circulation — Log	Visual Check of Furnace Loading — Log
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Annealing furnace atmosphere — batch type	Each charge by cycle	Each charge	Each charge	Daily	Calibrat. unnec-essary; change only as req'd	Each charge (con-trolled by dew point)	FSTDC	FSTDC	NA	NA	NA	NA	Each charge by cycle	NA	NA	NA
Tempering and stress relieving furnaces	Each lot or batch	NA	NA	Daily	Monthly	NA	NA	NA	NA	NA	NA	Monthly	Each lot or batch	NA	NA	NA
Endothermic gas generator	Start of each shift	4 hr	NA	Daily	Monthly	NA	NA	NA	NA	Daily	FSTDC	NA	NA	NA	NA	NA
Nitrogen generators	NA	FSTDC	NA	NA	NA	NA	NA	NA	NA	8 hr	FSTDC	NA	NA	NA	NA	NA
Ammonia dissociators	Start of each shift	FSTDC	4 hr	Daily	Monthly	NA	NA	NA	NA	NA	FSTDC	NA	NA	NA	NA	NA

GENERAL NOTE:
Legend: NA — not applicable
FSTDC — frequently sufficient to demonstrate control

NOTES:
(1) This check may be omitted if furnace is under automatic atmosphere control; however, a daily calibration check of atmosphere instrument should be made and logged.
(2) When process gas in a furnace is changed (for example, carburizing to hardening), the correct furnace atmosphere required for the new process should be fully developed within the furnace as established by CO_2 or dew point analysis before the new production parts can be started in the furnace. When changing over a furnace atmosphere from one utilizing ammonia to one in which no ammonia is to be used, the ammonia supply line should be *physically disconnected* from the furnace (to avoid any possibility of shutoff valve leakage).

TABLE C 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
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
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
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
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
Chrome electrodeposited plating	NA	Daily	NA	NA	NA	MA	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
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
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

(Notes follow on page 15.)

NOTES TO TABLE C

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.

APPENDIX II
ORDERING INFORMATION

(This Appendix is not part of ASME B18.18.5M-1998 and is included for informational purposes only.)

Specifications

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

Example

(a) ASME B18.18.5M, Inspection and Quality Assurance Plan Requiring In-Process Inspection and Controls.
(b) Thread acceptability shall be based on the thread acceptability paragraph in ASME B1.3M with an A inspection level.

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