AEROSPACE MATERIAL SPECIFICATION

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Superseding AMS-QQ-S-763B

Steel, Corrosion Resistant, Bars, Wire, Shapes, and Forgings

RATIONALE

AMS-QQ-S-763C restores this document to active status for the purpose of correcting errors in the table of similar specifications. Users are advised that the Aerospace Materials Division of SAE does not consider this specification to reflect currently recommended standards, and should not be specified for new design. Further, it is planned to place this document in a stabilized status immediately following publication of this revision.

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FIGURE A - SIMILAR SPECIFICATIONS FOR PRODUCTS COVERED BY AMS-QQ-S-763

Product Form	Bar		Wire		Shapes		Forgings	
Class	ASTM	AMS	ASTM	AMS	ASTM	AMS	ASTM	AMS
	Annealed							
202	A 276	(2)	(1)	(1)	A 276	(2)	A 473	(2)
302	A 276	5636	A 684/A 684M	5636	A 276	(2)	A 473	(2)
S30430	A 493	(2)	A 493	(2)	(3)	(3)	(3)	(3)
304	A 276	5639	A 580/A 580M	5639	A 276	5639	A 473	5639
304L	A 276	5647	A 580/A 580M	5647	A 276	5647	A 473	5647
305	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
309	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
310	A 276	5651	A 580/A 580M	5651	A 276	5651	A 473	5651
316	A 276	5648	A 580/A 580M	5648	A 276	5648	A 473	5648
316L	A 276	5653	A 580/A 580M	5653	A 276	5653	A 473	5653
317	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
321	A 276	5645	A 580/A 580M	5645	A 276	5645	A 473	5645
347	A 276	5646	A 580/A 580M	5646	A 276	5646	A 473	5646
384	A 493	(2)	A 493	(2)	(3)	(3)	(3)	(3)
403	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
405	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
410	A 276	5613	A 580/A 580M	5613	A 276	5613	A 473	5613
414	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
420	A 276	5621	A 580/A 580M	5621	A 276	5621	A 473	5621
430	A 276	5627	A 580/A 580M	5627	A 276	5627	A 473	5627
440A	A 276	5631	A 580/A 580M	(2)	A 276	(2)	A 473	5631
440B	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
440C	A 276	5630	A 580/A 580M	5630	A 276	5630	A 473	5630
446	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	A 473	(2)
	High Tensile							
202	A 276	(2)	(1)	(1)	(3)	(3)	(3)	(3)
302	A 276	5637	A 313/A 313M	5637	(3)	(3)	(3)	(3)
304	A 276	5857	A 313/A 313M	5857	(3)	(3)	(3)	(3)
316	A 276	(2)	A 313/A 313M	(2)	(3)	(3)	(3)	(3)
317	(1)	(1)	A 478	(2)	(3)	(3)	(3)	(3)
403	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	(1)	(1)
410	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	(1)	(1)
	Hard Temper							
403	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	(1)	(1)
410	A 276	(2)	A 580/A 580M	(2)	A 276	(2)	(1)	(1)
414	A 276	(2)	(1)	(1)	A 276	(2)	A 473	(2)

(1) Not covered by either an ASTM or an AMS.
(2) Not covered by an AMS.
(3) Product form and/or temper not applicable to this alloy.

NOTICE

The initial SAE publication of this document was taken directly from U.S. Military Standard QQ-S-763F. This SAE Standard may retain the same part numbers established by the original military document.

Any requirements associated with Qualified Products Lists (QPL) may continue to be mandatory for DoD contracts. Requirements relating to QPLs have not been adopted by the SAE for this standard and are not part of this SAE document.

1. SCOPE AND CLASSIFICATION

1.1 Scope

This specification covers corrosion-resistant steel bars, wire, shapes, and forgings.

1.2 Classification

1.2.1 Corrosion-resistant steel shall be furnished in the following classes, conditions, forms, and finishes, as specified (See 6.3).

1.2.1.1 Classes and Conditions

The material shall be furnished in the classes and conditions shown in Table 2.

1.2.1.2 Forms

1.2.1.2.1 Bars

Any size that is round, square, rectangular (excluding plate), hexagon, or octagon, furnished in straight lengths regardless of finish that is produced by rolling, extruding, forging, etc. Flat rolled product up to 10 inches inclusive in width and 0.125 inches and over in thickness is classified as bar. (All cold reduced flat material under 0.1875 inches in thickness is classified as strip if it is over 0.375 inches in width.)

1.2.1.2.2 Wire

Any size round or shaped cold finished product that is supplied in coils.

1.2.1.2.3 Forgings

Parts produced by hot mechanical shaping of such products as bars, billets or other semifinished materials, using hammers presses and forging machines.

1.2.1.2.4 Shapes

A solid section other than bar or wire, furnished in straight lengths (includes structural angles, channels, tees, and zees).

1.2.1.3 Finish

1.2.1.3.1 Hot Finished (conditions A, T, and H only, bar only)

Bars in the hot-finished condition can be ordered with one of the following finishes:

a. Hot finished, scale not removed (excluding spot conditioning)

b. Pickled or blast cleaned and pickled

c. Rough turned (round bars only)

1.2.1.3.2 Cold Finished (bars only)

Bars in the cold-finished condition can be ordered with one of the following finishes:

a. Cold drawn or cold rolled (conditions A and B only)

b. Centerless ground or smooth turned (all conditions, round bars only)

c. Polished (all conditions, round bars only)

1.2.1.3.3 Wire

Wire is usually furnished with a cold drawn finish, any exceptions need to be specified in the purchase order.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the

2.1 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, http://quicksearch.dla.mil/.

MIL-H-6875 Heat Treatment of Steel, Process for

MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage

FED-STD-123 Marking for Domestic Shipment (Civilian Agencies)

FED-STD-183 Continuous Identification Marking of Iron and Steel Products

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 262 Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

ASTM A 342 Permeability of Feebly Magnetic Materials

ASTM A 370 Mechanical Testing of Steel Products

ASTM A 484/484M General Requirements for Stainless and Heat-Resisting, Bars, Billets, and Forgings

ASTM A 555 General Requirements for Stainless and Heat-Resisting Steel Wire and Wire Rods

ASTM A 751 Standards Test Methods, Practices, and Terminology for the Chemical Analysis of Steel Products

ASTM D 3951 Commercial Packaging

3. REQUIREMENTS

3.1 Material

The material may be made by one or more of the following processes: electric furnace, electric-induction, vacuum furnace or other suitable commercial processes. If a specific melting practice is required by the purchaser, it shall be specified on the purchase order (See 6.3).

3.2 Non-finishing Surface Processing

3.2.1 Grinding

Bars and forgings may be ground to remove surface defects, provided such grinding does not reduce the thickness or width at any point below the allowable dimensional tolerances. An abrasive wheel shall be used for such grinding and shall be operated at a speed proper to insure that defective areas are cleanly cut out. Grinding shall not be so severe as to change the metallurgical condition of the material.

3.2.2 Cleaning

Unless otherwise specified in the contract or order, structural changes shall be subjected to a final cleaning treatment for the removal of scale, by the use of an appropriate cleaning solution such as nitric or nitric and hydrofluoric acid (See 6.3).

3.3 Rough Forgings

Rough forgings shall have sufficient excess stock to permit finishing to required dimensions without excessive waste. Allowances for machining shall be specified (See 6.3).

3.4 Chemical Composition

The material shall conform to the chemical composition shown in Table 3 and shall be within the check analysis tolerances shown in ASTM A 484 or ASTM A 555 as applicable.

3.5 Mechanical Properties

The material shall conform to the mechanical properties shown in Table 4 for the respective conditions. Heat treatable grades (400 series) shall develop the properties specified for the T or H conditions when subjected to thermal treatment in accordance with MIL-H-6875 and as specified or recommended by the purchaser.

3.6 Macrostructure

For classes 410, 420, 440A, 440B, and 440C, the macrostructure of the material shall be sound, free from pipes, fissures, gas cavities, sponginess, abnormal inclusions or segregations, or unusually numerous pin-holes when tested in accordance with 4.5.3. This requirement applies only to the classes specified in this paragraph.

3.6.1 Forging Grain Flow

The selection of forging blank size and orientation and forging technique shall provide a grain flow pattern essentially parallel to major-stressed surface areas of the finished part as indicated by design information (See 6.3). The grain flow pattern shall be free from re-entrant and sharply folded flow lines.

3.7 Magnetic Permeability

When low magnetic permeability is specified (See 6.2), class 304, in the annealed condition, shall show a magnetic permeability not higher than 1.02 at 200 oersteds (air equal to 1.00). When low magnetic permeability is specified for classes other than 304, the acceptable magnetic permeability values shall be as specified (See 6.3) and the inspection procedure shall be in accordance with ASTM A 342.

3.8 Resistance to Intergranular Corrosion (precipitated carbides)

Classes 304 - condition A, 304L, 316 - condition A, 316L, 317 - condition A, 321, and 347 shall be free from precipitated grain boundary carbide networks which result in intergranular corrosion. These steels shall be considered acceptable when specimens pass the specified test of 4.5.4. This requirement applies only to the classes and conditions specified in this paragraph.

3.9 Dimensional Tolerances

3.9.1 Bars, Shapes, and Wire

For bars and shapes, the tolerances shall conform to the applicable requirements of ASTM A 484. For wires, the tolerances shall conform to the applicable requirements of ASTM A 555. When exact lengths are not ordered (See 6.3), bars will be accepted in mill lengths of 6 to 20 feet but not more than 10 percent of any order shall be furnished in lengths shorter than 10 feet.

3.9.2 Structural Shapes

3.9.2.1 Weight

Structural shapes of 6 pounds per linear-foot or less will be acceptable if the actual weights are not over 7-1/2 percent above or 7-1/2 percent below the ordered weights. Shapes over 6 pounds per linear foot will be accepted if the weights are not over 4-1/2 percent above or 4-1/2 percent below the ordered weights.

3.9.2.2 Size

Sections having legs or flanges up to 6 inches, inclusive, shall not exceed 1/8 inch over or under the ordered length or width of legs or flanges. Sections having legs or flanges over 6 inches shall not exceed 3/16 inch over and 1/8 inch under the ordered length or width of legs and flanges. The maximum depth of grinding for spot conditioning shall not exceed 10 percent of the thickness of the shape at any point of conditioning.

3.9.3 Forgings

All forgings shall conform to the sizes and shapes as specified (See 6.3). When dimensional tolerances are not included in the contract or order, forgings measured on their diameters or between parallel faces shall not vary from the specified dimensions by more than plus 3/32 inch on smooth forgings or plus 1/32 inch on rough machined forgings. Dimensional tolerances for finished forgings shall be as specified on the applicable drawings.

3.10 Identification Marking

3.10.1 Bars (continuous marking)

When specified by the procuring activity, continuous identification marking shall be in accordance with FED-STD-183. Each round, square, and flat bar 1 inch and over, each hexagon, square, and flat 7/8 inch and over, and each octagon 1 inch and over shall be printed in ink with constantly recurring symbols including a coding of the name or trademark of the manufacturer and an identifying designation consisting of the class number and a condition designator selected from FED-STD-183. The symbols shall be repeated at intervals not greater than 3 feet. The identifying designator shall be coded as shown in the following example (See 6.3).

Class number 304
Condition designator A

For rounds, and bars less than 1 inch, hexagons, squares and flats less than 7/8 inch, and octagons less than 1 inch, the same information shall be marked or printed on substantial tags securely affixed to each end of each bundle with a third tag placed inside the bundle near the middle.

3.10.2 Shapes and Shaft Forgings

Shapes and shaft forgings shall be die or rubber stamped or marked with a non-water-soluble ink on one end with the following information:

Class number.
Condition designator.

3.10.3 Forgings (except shaft forgings)

Each forging shall be marked with the manufacturer's name or trademark, drawing or die number, heat and forging number, class number, and a condition designator. Small forgings shipped in bundles, of such size that individual marking is not practical, shall have the above information printed on substantial tags securely affixed to each end of each bundle with a third tag placed inside the bundle near the middle.

3.10.4 Wire

Unless other identification is specified in the contract or purchase order (See 6.3), wire shall be identified by metal tags, impression stamped with the legend specified in FED-STD-183, and shall be attached to each coil.

3.11 Workmanship

The material shall be uniform in quality and condition, free from pipe and flakes or heat checks, and shall contain no welds or defects such as seams, laps, cracks, slag, hard spots, porosity, slivers, scabs, rolled-in scale, fissures, gas cavities, sponginess, nonmetallic inclusions, and undue segregation, which due to the nature, degree, or extent may detrimentally affect the suitability for the service intended.

3.12 Heat Treatment

Heat treatment shall be in accordance with MIL-H-6875. AMS2750 pyrometry requirements do not apply to furnaces used only for heat treating material to condition A. The annealing procedure for S30430 and 384 shall be in accordance with the table below, in addition to the requirements set forth in MIL-H-6875.

TABLE 1

AISI or UNS Designation	Annealing treatment	
	Heating, °F	Cooling
S30430	1850 to 2100	Water quench
384	1900 to 2100	Water quench

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

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

4.2 Lot

a. For the purpose of chemical analysis a lot shall consist of all bars, wire, shapes, and forgings made from the same heat and presented for inspection at the same time.

b. For all other tests, a lot shall consist of all product of the same size, same heat, and produced under the same processing conditions. For austenitic, ferritic, and martensitic classes in the annealed condition, a lot may consist of product that is heat treated in more than one charge in the same furnace, or in several furnaces, using the same processing parameters (See 6.7). For martensitic stainless steels heat treated to the T or H condition, however, a lot shall consist of product of the same size, same heat, and the same heat treat charge in a batch type furnace, or under the same processing conditions without interruption within 24 hours in a continuous type furnace.

4.2.1 Forgings

Unless another lot definition is specified in the contract or order (See 6.3), a lot shall consist of one forging for forgings weighing 250 pounds or more, and 1000 pounds maximum for forgings weighing less than 250 pounds each with the forgings in each lot to be of one class and shape only, made from the same heat and subjected to the same heat treating procedure (annealing or tempering).

4.3 Sampling Procedure

4.3.1 Chemical Analysis

For the purpose of chemical analysis of 4.5.1, one sample shall be taken from each lot. When a lot is a portion of a heat previously subjected to chemical analysis and in compliance with the specified composition range, additional analysis sampling is waived. In the event a portion of a lot is not properly identified, an analysis shall be made of each piece or as required by the purchaser. Sampling shall conform to the applicable chemical analysis document specified in ASTM A 751.

4.3.2 Macrostructure Examination

Samples shall be selected as shown below. In special cases where more than the usual number of macrostructure etch tests are required, the number of such tests shall be as specified in the contract or order (See 6.3).

4.3.2.1 Heat Qualification

4.3.2.1.1 Heats of Top Poured Ingots

Samples shall be taken from semi-finished or finished product representing the top and bottom of the first ingot and last usable ingot from heats having not more than 10 ingots or not over 30 tons or from portions of heats within these limits, and from the top and bottom of the first, middle, and last usable ingot of heats having more than10 ingots or over 30 tons.

4.3.2.1.2 Heats of Bottom Poured Ingots

Samples shall be taken from semi-finished or finished product representing the top and bottom of three ingots. One ingot shall be taken at random from the first usable plate poured, one ingot at random from the usable plate poured nearest to the middle of the heat, and one ingot at random from the usable plate poured. When a heat consists of two usable plates, two of the sample ingots shall be selected from the second usable plate poured. When a heat consists of a single usable plate, any three ingots at random may be selected. If there are less than three ingots in the heat, samples shall be taken representing the top and bottom of all ingots.

4.3.2.1.3 Strand Cast Heats

Samples shall be taken from semi-finished or finished product having at least a 3:1 reduction in cross-section from the cast strand, or samples of the as-cast strand similarly reduced, representing the front, middle, and back of both strands when two strands are cast, or of an inside strand and an outside strand when more than two strands are cast. When a single strand is cast, six samples having at least a 3:1 reduction from the cast strand, or samples of the cast strand similarly reduced, representing both ends of the first, middle, and last usable cuts (blooms) of the strand or product shall be taken.

4.3.2.2 Product Qualification

Samples shall be taken at random from not less than 10 percent of the pieces of each lot. A lot shall be all product of one size from one heat in one shipment. Not less than three or more than ten samples shall be selected from a lot, except that if the quantity in the lot is three pieces or less, one sample shall be taken from each piece.

4.3.3 Mechanical Tests

Sample(s) from each lot of bars, wire and shapes (rolled, extruded or forged) and from each lot of forgings, shall be selected for the tests specified in 4.5.2. Test specimens shall be taken from the selected pieces as follows:

4.3.3.1 Bars, Wire, and Shapes

One longitudinal tension test specimen shall be taken from each sample item and tested as specified in 4.5.2.

4.3.3.2 Forgings

4.3.3.2.1 250 pounds and Over

Unless otherwise specified in the contract or order, each forging weighing 250 pounds or more shall be tested individually. One tension test specimen shall be taken from a prolongation on each end of each forging. The test specimens shall be taken midway between the center and outside of the cross section of the forging.

4.3.3.2.2 Under 250 pounds

For forgings weighing less than 250 pounds two tension test specimens shall be taken from two sample forgings to represent the lot. One tension test specimen shall be taken from one forging and the remaining tension test specimen from the other forging. Test specimens shall be taken from suitable prolongations of the forgings, as specified by the procuring activity (See 6.3), or at the option of the contractor, forgings in excess of the number required may be provided for tests. For each forging weighing less than 250 pounds submitted individually, one tension specimen shall be taken.

4.3.3.2.3 Multiples

Where forgings are made in multiples from a single forging, that is, forged in one piece and machined apart, individual tests of each forging need not be made, but tests of the large forging shall govern.

4.3.4 Magnetic Permeability

When specified (See 3.7), one sample shall be selected from each lot. The specimens shall be 3 inches long, the thickness or diameter shall be 1/2 inch for material 1/2 inch and over in thickness or diameter, and the full size of the material, if the material is under 1/2 inch in thickness or diameter. The specimens shall be ground and polished all over. Specimens, since they represent annealed material, may be annealed and pickled after machining.

4.3.5 Precipitated Carbides Test

A minimum of one sample shall be selected from each lot for the test specified in 4.5.4 to determine conformance to the requirements of 3.8.

4.4 Examination

4.4.1 Dimensional and Visual Surface Inspection

All material shall be subject to dimensional and visual surface inspection to determine whether the material conforms to this specification. Lots containing defective material shall be rejected.

4.4.2 Reinspection

Lots rejected on account of dimensional or visual surface defects may be resubmitted for inspection in accordance with 4.4.1 after the manufacturer has reworked and reinspected them to remove nonconforming material.

4.5 Tests

4.5.1 Chemical Analysis

Samples selected in accordance with 4.3.1 shall be analyzed to determine conformance with Table 3 in accordance with any one of the chemical analysis methods specified in ASTM A 751. If any sample fails to conform to Table 3, the entire lot shall be rejected.

4.5.2 Mechanical Tests

4.5.2.1 Tensile Test

The tension tests shall be made in accordance with ASTM A 370 using either the 0.2% offset method or the extension under the load method using the limiting plastic strain of 0.002 in/in when determining the yield strength. The tensile specimens shall be prepared in accordance with ASTM A 370, form and dimension as applicable. No lot will be accepted if the yield strength of any one specimen is below the minimum yield strength shown in Table 4.

4.5.2.2 Hardness Test

The number of hardness tests shall be sufficient to establish the uniformity of hardness of the material in each lot. Hardness tests, as applicable for specimen size, shall be conducted in accordance with ASTM A 370. Failure of any sample to meet the requirements of this specification shall be cause for rejection of the lot.

4.5.3 Macrostructure Test

The specimens for the macrostructure test shall be cut from the ends of the selected sample and shall represent the full cross section bar, billet, wire, shape, or forging. The surfaces of the specimens to be examined shall be prepared for etch testing. The prepared specimens shall first be cleaned and heated in water to the same temperature as the acid etching solution. It shall then be immersed in a solution consisting of equal parts, by volume, of concentrated hydrochloric acid and water at approximately 160 °F, for a period of time sufficient to develop fully the metallurgical structure. Fresh acid shall be used for each lot of specimens. After etching, the specimens shall be washed in running water or steam and any deposit removed by scrubbing. The dried specimen shall then be dipped in cold concentrated nitric acid, washed in cold water, and dried. If the specimen fails to conform to 3.6, the lot represented shall be rejected.

4.5.4 Intergranular Corrosion Tests (precipitated carbides)

Specimens selected as specified in 4.3.5 shall be tested in accordance with Practice E of ASTM A 262.

4.5.5 Rejection and Retest

Failure of a specimen to meet a test requirement shall be cause for rejection of the lot. At the discretion of the procuring activity, retest will be permitted (See 6.3). A retest sample of three specimens shall be tested to replace each failed specimen of the original sample. If one of the retest samples fails, the lot shall be rejected with no further retesting permitted. Where failure of any lot of material to meet the requirements to this specification is due to inadequate heat treatment, the material may be reheat-treated and resubmitted for test. Only two such reheat-treatments shall be allowed.

4.6 Inspection of Preparation for Delivery

The preservation, packing, and marking of the bars, shapes, wire and forgings shall be examined to determine compliance with the requirements of Section 5.

5. PACKAGING

5.1 Preservation

Preservation is not required.

5.2 Packing

Packing shall be Level A or Level C, as specified.

5.2.1 Level A

Bars, shapes, and wire shall be prepared for shipment in accordance with MIL-STD-163. Forgings of such size requiring consolidation or having fragile appendages shall be packed in containers specified in MIL-STD-163. Polished surfaces shall be interleaved or otherwise protected with a nonabrasive paper.

5.2.2 Level C

The subject material shall be segregated by class, heat, condition, form, size, and finish as applicable, prior to packing. Packing of the material shall be in accordance with ASTM D 3951. In addition, polished surfaces shall be interleaved or otherwise protected with a nonabrasive paper.

5.3 Marking

5.3.1 Military Agencies

In addition to any special marking required in the contract or order (See 6.3), marking for shipment shall be in accordance with MIL-STD-163.

5.3.2 Civil Agencies

In addition to any special marking required in the contract or order (See 6.3), marking of shipping containers shall be in accordance with FED-STD-123. Unless otherwise specified in the contract or order, shipments shall be marked with: the name of the material, the class and condition, and the quantity contained therein as defined by the contract or order under which shipment is made, the name of the contractor, the number of the contract or order, and the gross weight.

6. NOTES

INFORMATION FOR GUIDANCE ONLY. This section contains information of a general or explanatory nature which is helpful, but is not mandatory.

6.1 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

6.2 Intended Use

6.2.1 Classes 202, 302, and 305

When sensitization cannot be tolerated classes 202, 302 and 305 are not recommended for use.

6.2.1.1 Classes 202 and 302

Class 302 is intended for use where severe corrosion is not a problem and no welding other than spotwelding is employed except when welding is followed by annealing. Class 202 is intended as a substitute for class 302.

6.2.1.2 Class 305, 384, and UNS S30430

These materials are intended for use where a lower rate of work hardening than classes 302 or 304 and less change of magnetic permeability are required. UNS S30430 is primarily used for cold headed fasteners.

6.2.2 Class 304, Condition B

This material is intended primarily for structural applications where welding is limited to spot welding unless welding is followed by annealing.

6.2.3 Classes 304L, 316L, 321, 347, 304, and 316 - Condition A

These materials are generally preferred for resistance to most severely corrosive media, and are generally more resistant than the other types.

6.2.4 Class 317, Condition A

This material exhibits superior corrosion resistance to most severely corrosive media and is used in special applications.

6.2.5 Classes 316, 317

When these Molybdenum-bearing stainless steels are intended for use in nitric acid environments, corrosion testing in accordance with ASTM A 262, practice C is recommended.

6.2.6 Classes 304L, 316L, 321 and 347 - Condition A

These materials are intended primarily for use in applications where welding is necessary, subsequent annealing and quenching is impracticable, and exposure to most severely corrosive media is involved.

6.2.7 Classes 309 and 310

These materials are intended for the highest temperature applications requiring high temperature strength and resistance to oxidation.

6.2.8 Class 403

This material is intended for use in applications where high mechanical properties, corrosion, abrasive wear and wet erosion resistance are required.

6.2.9 Class 405

This material is used in applications where marked hardening is undesirable when cooling from elevated temperatures.

6.2.10 Classes 410 and 430

These materials are intended for structural parts in application where corrosive conditions are not severe, class 430 being the better alloy. Class 410 is hardenable by heat treatment; class 430 is not hardenable. These alloys are subject to rusting and pitting when exposed to sea water and will rust in salt air.

6.2.11 Class 414

This material is heat treatable to slightly higher mechanical properties than those of class 410. Corrosion resistance is similar to class 410.

6.2.12 Class 420

This material is intended for use in ball and roller bearings, cutlery, and other parts requiring high hardness.

6.2.13 Class 440A

This material is used where material of greater hardness than class 420 and greater toughness than class 440B and 440C is required.

6.2.14 Class 440B

This material is used for applications requiring an intermediate hardness between class 440A and 440C.

6.2.15 Class 440C

This material is suitable for use where extremely high hardness and wear-resistance are desirable in a corrosion-resistant steel. It is intended for use in ball and roller bearings and races, cutting edges, shear blades, surgical and dental equipment, valve seats and other applications requiring high hardness.

6.2.16 Class 446

This material is used principally for the manufacture of parts which must resist high temperatures in service without scaling.

6.3 Ordering data

Purchasers should select the preferred options permitted herein and include the following information in procurement documents.

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

b. Class, condition, form and finish (1.2 and Table 2).

c. Specify melting practice, if required (See 3.1).

d. Specify other cleaning process or if cleaning is not required (See 3.2.2).

e. Allowances for machining (See 3.3).

f. Major stressed surface areas of the finished part (See 3.6.1).

g. Whether low magnetic permeability is required for class 304 condition A, and the acceptable permeability values for classes other than 304 if such testing is desired (See 3.7).

h. Whether exact or mill lengths are required (See 3.9.1).

i. Size and shape of forgings (See 3.9.3).

j. Whether continuous marking or other identification marking is required (See 3.10.1 and 3.10.4).

k. Other lot definition for forgings (See 4.2.1).

l. Number of macrostructure samples required for special cases (See 4.3.2).

m. Forging prolongations for testing (See 4.3.3.2.2).

n. Whether retests are permitted (See 4.5.5).

o. Whether the material should be prepared for shipment by level A or C (See 5.2).

p. Whether special marking for shipment is required (See 5.3).

6.4 Class 431

Class 431 under QQ-S-763C should be purchased to MIL-S-18732.

6.5 Free Machining Grades

Classes 303, 303Se, 416, 416Se, 430F and 430FSe under QQ-S-763C should be purchased to ASTM A 582 or ASTM A 581.

6.6 Cross-reference of Designations

Designations of the various classes covered by this specification and the designations of the most nearly equivalent classes in other Government specifications are shown in Table 5. This table is for reference purposes only.

6.7 Equivalent Processing Parameters

Product of the same size and from the same heat that is heat treated in different furnace charges can be considered to be a part of the same lot provided the heat treating procedure is the same and all furnaces used are similar in size and meet the temperature uniformity and accuracy requirements of a documented furnace quality assurance program.

TABLE 2 - CLASSES AND CONDITIONS

Class	Condition 1/			
	Annealed "A"	Cold Worked High Tensile "B"	Intermediate temper " T "	Hard Temper " H "
202	A	B	-	-
302	A	B	-	-
UNS S30430	A	-	-	-
304	A	B	-	-
304L	A	-	-	-
305	A	-	-	-
309	A	-	-	-
310	A	-	-	-
316	A	B	-	-
316L	A	-	-	-
317	A	B	-	-
321	A	-	-	-
347	A	-	-	-
384	A	-	-	-
403	A	-	T	H
405	A	-	-	-
410	A	-	T	H
414	A	-	-	H
420	A	-	-	-
430	A	-	-	-
440A	A	-	-	-
440B	A	-	-	-
440C	A	-	-	-
446	A	-	-	-

1/ Forgings (conditions A, T and H only).

TABLE 3 - CHEMICAL COMPOSITION, PERCENT 1/

Class	Carbon	Manga-nese	Phos-phorous	Sulphur	Silicon	Chrom-ium	Nickel	Molyb-denum	Titan-ium	Columb-ium + Tantalum	Alum-inum	Nitro-gen	Copper
202	0.15	7.50/ 10.00	0.06	0.03	1.00	17.0/ 19.0	4.0/ 6.0	---	---	---	---	0.25	---
302	0.15	2.00	0.045	0.03	1.00	17.0/ 19.0	8.0/ 10.0	1.00	---	---	---	0.10	1.00
304	0.08	2.00	0.045	0.03	1.00	18.0/ 20.0	8.0/ 10.5	1.00	---	---	---	0.10	1.00
304L	0.03	2.00	0.045	0.03	1.00	18.0/ 20.0	8.0/ 12.0	1.00	---	---	---	0.10	1.00
S30430	0.03	2.00	0.045	0.03	1.00	17.0/ 19.0	8.0/ 10.0	---	---	---	---	---	3.0/ 4.0
305	0.12	2.00	0.045	0.03	1.00	17.0/ 19.0	10.50/ 13.0	1.00	---	---	---	---	1.00
309	0.20	2.00	0.045	0.03	1.00	22.0/ 24.0	12.0/ 15.0	1.00	---	---	---	---	1.00
310	0.25	2.00	0.045	0.03	1.50	24.0/ 26.0	19.0/ 22.0	1.00	---	---	---	---	1.00
316	0.08	2.00	0.045	0.03	1.00	16.0/ 18.0	10.0/ 14.0	2.0/ 3.0	---	---	---	0.10	1.00
316L	0.03	2.00	0.045	0.03	1.00	16.0/ 18.0	10.0/ 14.0	2.0/ 3.0	---	---	---	0.10	1.00
317	0.08	2.00	0.045	0.03	1.00	18.0/ 20.0	11.0/ 15.0	3.0/ 4.0	---	---	---	0.10	1.00
321	0.08	2.00	0.045	0.03	1.00	17.0/ 19.0	9.0/ 12.0	1.00	5X carbon min.	---	---	---	1.00

TABLE 3 - CHEMICAL COMPOSITION, PERCENT 1/ (CONTINUED)

Class	Carbon	Manga-nese	Phos-phorous	Sulphur	Silicon	Chrom-ium	Nickel	Molyb-denum	Titan-ium	Columb-ium + Tanatalum	Alum-inum	Nitro-gen	Copper
347	0.08	2.00	0.045	0.03	1.00	17.0/ 19.0	9.0/ 13.0	1.00	...	10X carbon min.	...	...	1.00
384	0.04	2.00	0.045	0.03	1.00	15.0/ 17.0	17.0/ 19.0	...	...	...	...	...	1.00
403	0.15	1.00	0.040	0.03	0.50	11.5/ 13.0	...	...	...	...	...	...	...
405	0.08	1.00	0.040	0.03	1.00	11.5/ 14.5	...	...	...	...	0.10/ 0.30	...	...
410	0.15	1.00	0.040	0.03	1.00	11.5/ 13.5	...	...	...	...	...	...	...
414	0.15	1.00	0.040	0.03	1.00	11.5/ 13.5	1.25/ 2.50	...	...	...	...	...	...
420	0.15 min.	1.00	0.040	0.03	1.00	12.0/ 14.0	...	...	...	...	...	...	...
430	0.12	1.00	0.040	0.03	1.00	16.0/ 18.0	...	...	...	...	...	...	...
440A	0.60/ 0.75	1.00	0.04	.030	1.00	16.0/ 18.0	...	0.75	...	...	...	...	...
440B	0.75/ 0.95	1.00	0.04	.030	1.00	16.0/ 18.0	...	0.75	...	...	...	...	...
440C	0.95/ 1.20	1.00	0.04	.030	1.00	16.0/ 18.0	...	0.75	...	...	...	...	...
446	0.20	1.50	0.04	.030	1.00	23.0/ 27.0	...	...	...	...	...	0.25	...

1/ Single values are maximum values unless otherwise indicated.

TABLE 4 - MECHANICAL PROPERTIES

Classes	Condition	Finish	Diameter or Thickness inches	Yield strength (min.) 0.2 percent offset psi	Ultimate tensile strength (min.)	Elongation in 2 inches (min.) percent	reduction in area (min.) percent	Brinnell hardness (max.) 4/
202, 302, 304, 305	A	Hot	0.500 and less	-----	115,000 (max.)	....	....	....
			over 0.500	30,000	75,000 1/	40	50	....
309, 310, 316		Cold	0.500 and less	-----	125,000 (max.)	...	....	....
			over 0.500	30,000	75,000 1/	30	50	....
317, 321, 347			0.500 and less	...	125/155,000	....	....	....
202, 302, 304	B	Cold	over 0.500 to 0.750	100,000	125,000	12	35	....
			0.751 to 1.000	80,000	115,000	15	35	....
			1.001 to 1.250	65,000	105,000	20	35	....
			1.251 to 1.500	50,000	100,000	28	45	....
			1.501 to 1.750	45,000	95,000	30	45	....
			over 1.750	30,000	75,000	35	50	....
316, 317	B	Cold	0.500 and less	....	110/140,000	....	....	....
			0.501 to 0.750	95,000	110,000	15	45	....
			0.751 to 1.000	80,000	100,000	20	45	....
			1.001 to 1.250	65,000	95,000	25	45	....
			1.251 to 1.500	50,000	90,000	30	45	....
304L 316L	A	Hot	0.500 and less	....	115,000 (max.)	....	....	....
			over 0.500	25,000	70,000	40	50	....
		Cold	0.500 and less	....	115,000 (max.)	....	....	....
			over 0.500	25,000	70,000	30	40	....