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SUPERSEDING
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FEDERAL SPECIFICATION

STEEL BARS, WIRE, SHAPES, AND
FORGINGS, CORROSION RESISTING

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers corrosion-resisting steel bars, wire, shapes, and forgings.

1.2 Classification.

1.2.1 Corrosion-resisting steel shall be furnished in the following classes, conditions, forms, and finishes, as specified (see 6.2).

1.2.1.1 Classes and conditions. The material shall be furnished in the classes and conditions shown in Table I.

1.2.1.2 Forms.

1.2.1.2.1 Bars. Hot finished rounds, squares, octagons and hexagons: 1/4 inch and over in diameter or size. Hot finished flats: 1/4 to 10 inches, inclusive, in width, 1/8 inch and over in thickness. Cold finished rounds, squares, octagons, hexagons and shapes: over 1/2 inch in diameter or size. Cold finished flats: 3/8 inch and over in width, 1/8 inch and over in thickness. Widths less than 3/8 inch and thicknesses less than 3/16 inch are generally described as flat wire. Thicknesses 1/8 to under 3/16 inch can be cold rolled strip as well as bar.

AMSC N/A

FSC 9510

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TABLE I. Classes and conditions.

Class	Condition [1]			
	A Annealed	B Cold Worked high tensile	T Intermediate temper	H Hard Temper
202	A	B	-	-
305	A	B	-	-
304	A	B	-	-
304L	A	-	-	-
305	A	-	-	-
309	A	-	-	-
310	A	-	-	-
316	A	B	-	-
316L	A	-	-	-
317	A	B	-	-
321	A	-	-	-
347	A	-	-	-
403	A	-	T	H
405	A	-	-	-
414	A	-	T	H
410	A	-	-	H
420	A	-	-	-
430	A	-	-	-
440A	A	-	-	-
440B	A	-	-	-
440C	A	-	-	-
446	A	-	-	-

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

1.2.1.2.2 Wire. Cold finished only: round, square, octagon, and hexagon shaped wire, 1/2 inch and under in diameter or size. Cold finished only: flat wire, 1/16 to under 3/8 inch in width, 0.010 to under 3/16 inch in thickness.

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

1.2.1.2.4 Shapes. A solid section other than rectangular, square or standard rod and wire sections, furnished in straight lengths (includes structural angles, channels, tees, and zeos).

1.2.1.3 Finish.

(a) Hot finished (conditions A, T, and H only, bar only). Bars in the hot-finished condition which will conform to the tolerances shown in 1d1, 1d2, 1d3, and 1d5 of Fed. Std. No 48 are furnished with one of the following finishes:

Hot worked, scale not removed (excluding spot conditioning),
Pickled or blast cleaned and pickled,
Rough turned (round bars only).

(b) Cold finished (bars only). Bars in the cold-finished condition which will conform to the tolerances shown in 2d1, 2d2, 2d3, and 2d5 of Fed. Std. No. 48 are furnished with one of the following finishes:

Cold drawn or cold rolled (conditions A and B only),
Centerless ground or smooth turned (all conditions, round bars only),
Polished (all conditions, round bars only).

(c) Cold finished (wire only). Wire in the cold finished condition which will conform to the tolerances shown in 17d1 through 17d4 of Fed. Std. No. 48 is furnished with one of the following finishes:

Cold drawn,
Centerless ground (round only)
Polished (round only).

2. APPLICABLE DOCUMENTS

2.1 Government publications. The issues of the following documents in effect on date of invitation for bids or solicitation for offers, form a part of this specification to the extent specified herein.

Federal Standards:

Fed. Std. No. 48 - Tolerances for Steel and Iron Wrought Products.
Fed. Std. No. 66 - Steel: Chemical Composition and Hardenability.
Fed. Std. No. 123 - Marking for Domestic Shipment (Civilian Agencies).
Fed. Test Method Std. No. 151 - Metals: Test Methods.
Fed. Std. No. 183 - Continuous Identification Marking of Iron and Steel Products.

(Activities outside the Federal Government may obtain copies of Federal specifications, standards, and commercial item descriptions, as outlined under General Information in the Index of Federal Specifications, Standards and Commercial Item Descriptions. The Index, which includes cumulative bimonthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal specifications and commercial item descriptions required by activities outside the Federal Government for bidding purposes are available without charge from General Services Administration Business Service Centers in Boston, MA; New York, NY; Philadelphia, PA; Washington, DC; Atlanta, GA; Chicago, IL; Kansas City, MO; Fort Worth, TX; Houston, TX; Denver, CO; San Francisco, CA; Los Angeles, CA; and Seattle, WA.

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(Federal Government activities may obtain copies of Federal standardization documents and the Index of Federal Specifications, Standards, and Commercial Item Descriptions from established distribution points in their agencies.)

Military Specifications:

- MIL-H-6875 - Heat Treatment of Steel, Process for.
- MIL-S-18732 - Steel Bars, Billets, Forgings, Tubing, (431) Special Quality.

Military Standards:

- MIL-STD-163 - Steel Mill Products Preparation for Shipment and Storage.
- MIL-STD-288 - Inspection Procedure for Determining the Magnetic Permeability of Wrought Austenitic Steel.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM):

- ASTM A 262 - Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
- ASTM A 370 - Mechanical Testing of Steel Products.
- ASTM A 484/484M - Bars, Billets and Forgings, Stainless and Heat-Resisting, General Requirements for.
- ASTM A 555 - Wire, Steel, Stainless and Heat-Resisting, General Requirements for.
- ASTM A 581 - Free-Machining Stainless and Heat-Resisting Steel Wire
- ASTM A 582 - Free-Machining Stainless and Heat-Resisting Steel Bars Hot-Rolled or Cold-Finished
- ASTM D 3951 - Packaging, Commercial

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Material. The material shall 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 6.2).

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.

3.2.2 Cleaning. Unless otherwise specified in the contract or order, structural shapes 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 6.2).

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 6.2).

3.4 Chemical composition. The material shall conform to the chemical composition shown in Table II and shall be within the check analysis tolerances shown in Fed. Std. No. 66.

3.5 Mechanical properties. The material shall conform to the mechanical properties shown in Table III 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 producer.

3.6 Macrostructure. Macrostructure of the material shall be dense, 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.

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 6.2). The grain flow pattern shall be essentially 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 magnetic permeability requirements for these types and applicable nonmagnetic inspection procedure shall be in accordance with MIL-STD-288.

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3.8 Resistance to intergranular corrosion (precipitated carbides). Corrosion-resisting steel, 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 and wire. The dimensions of the material offered for delivery shall not vary from the ordered dimensions by amounts greater than those shown in the following paragraphs of Fed. Std. No. 48 (see 6.2). When exact lengths are not ordered, bars and wire 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.

Dimension	Paragraphs of FED-STD-48
Bars, hot-rolled:	
Diameter or distance across flats (round or square)	1d1
Distance across flats (hexagon or octagon)	1d2
Distance across flats (flat)	1d3
Straightness (machine straightened)	1d5
Bars, cold-finished:	
Diameter or distance across flats (round or square)	2d1
Diameter (round, ground or ground and polished)	2b2
Distance across flats (hexagon or octagon)	2d2
Distance across flats (flat)	2d3
Straightness (machine straightened)	2d5
Bars, general:	
Length (hot or cold cut)	1d4
Length (machine cut)	1d4
Wire, cold-finished:	
Drawn, centerless ground, centerless ground and polished wire, size tolerance	17d1
Wire for which the final operation is a surface treatment for the purpose of removing scale or drawing lubricant, size tolerance	
	17d2
Round wire, out-of-round tolerance	17d3
Straightened and cut wire, length tolerances	17d4

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 size 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 size 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 6.2). 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. No. 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. No. 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 6.2).

304

Class number _____

ANL

Condition designator _____

For round, and bars less than 1 inch, hexagons, square and flat less than 7/8 inch, octagons less than 1 inch, and wire less than 3/8 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.

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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 6.2), wire shall be identified by metal tags, impression stamped with 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, excessive 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.

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. 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. For the purpose of macrostructure examination, a lot shall consist of all bars, wire, or forgings of one size made from one heat of steel. For the purpose of mechanical tests, magnetic permeability, and precipitated carbide tests, the lots shall be as follows:

4.2.1 Bars, wire and shapes. Each heat of steel in each class and each heat treatment charge (except for cold worked material) shall be grouped into lots according to size as follows:

For conditions A, T, and H:

- (a) Up to and including 1-1/2 inches in diameter or equivalent cross-sectional area.
- (b) Over 1-1/2 inches, up to and including 3 inches, in diameter or equivalent cross-sectional area.

- (c) Over 3 inches, up to and including 5 inches, in diameter or equivalent cross-sectional area.
- (d) Over 5 inches in diameter or equivalent cross-sectional area.

For cold-worked material (condition B) not more than one size bar or wire shall be included in a lot.

4.2.2 Forgings. Unless another lot definition is specified in the contract or order (see 6.2), 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 drawing).

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 are 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 requirements of method 111 or 112 respectively, of Fed. Test Method Std. No. 151.

4.3.2 Macrostructure examination. Samples shall be selected from each of six semifinished billets from locations representing the tops and bottoms of each of 3 representative ingots or front, back and middle of each strand if continuously cast. Where this is not practicable, a sample shall be selected at random from each 2000 pounds in a lot. 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 6.2).

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 forging. The test specimens shall be taken midway between the center and outside of the cross section of the forging.

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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 6.2), 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 form 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. 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.

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 II in accordance with method 111 or 112 of Fed. Test Method Std. No. 151. If any sample fails to conform to Table II, the entire lot shall be rejected.

4.5.2 Mechanical test.

4.5.2.1 Tensile test. The tension tests shall be made in accordance with ASTM method A370 using either 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 A370, 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 III.

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 A370. 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 suitably 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 deg. 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 6.2). A retest of sample of three specimens shall be tested to replace each failed specimen of the original sample. If one of the retest specimens 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.

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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 6.2), 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 6.2), marking of shipping containers shall be in accordance with Fed. Std. No. 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

6.1 Intended use.

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

6.1.1.1 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.

6.1.1.2 Class 305. This material is intended for use where a lower rate of work hardening than classes 302 or 304 and less change of magnetic permeability are required.

6.1.2 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.

6.1.3 Classes 304L, 316L, 321, 347, 304, condition A, 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.

6.1.4 Class 317, condition A. This material exhibits superior corrosion resistance to most severely corrosive media and is used in special application.

6.1.5 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.

6.1.6 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.

6.17 Classes 309 and 310. These materials are intended for the highest temperature applications requiring high temperature strength and resistance to oxidation.

6.1.8 Class 403. This material is intended for use in applications where high mechanical properties, corrosion, abrasive wear and wet erosion resistance are required.

6.1.9 Class 405. This material is used in applications where marked hardening is undesirable when cooling from elevated temperatures.

6.1.10 Classes 410 and 430. These materials are intended for structural parts in application where corrosive conditions are not severe, class 430 being the better. 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.

6.1.11 Class 414. This material is heat treatable to slightly higher mechanical properties than those of class 410. Corrosion resistance is similar to class 410.

6.1.12 Class 420. This material is intended for use in ball and roller bearings, cutlery, and other parts requiring high hardness.

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

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

6.1.15 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.

6.1.16 Class 446. This material is used principally for the manufacture of parts which must resist high temperatures in service without scaling.

6.2 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 I).
- (c) Specify melting practice, if required (see 3.1).
- (d) Specify other cleaning processes or if cleaning is not required (see 3.2.2).
- (e) Allowances for machining (3.3).
- (f) Major stressed surface areas of the finished part (see 3.6.1).
- (g) Whether low magnetic permeability is required (see 3.7).
- (h) Whether exact or mill lengths are required (see 3.9.1).
- (i) Size and shape of forgings. Purchasers of forgings shall supply drawings showing indications of highly stressed areas (3.9.3).
- (j) Whether continuous marking or other identification marking is required (see 3.10.1 and 3.10.4).

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- (k) Other lot definition for forgings (see 4.2.2).
- (l) Number of microstructure 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).

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

6.4 Classes 303, 303Se, 416, 416Se, 430F and 430F Se under QQ-S-763C should be purchased to ASTM A 484 and ASTM A 582 or ASTM A 555 and 581.

6.5 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 IV. This table is for reference purposes only.

6.6 Subject term (key word) listing.

Corrosion-resisting steel
 Forgings, steel
 Shapes, steel
 Steel bars
 Steel wire

6.7 Changes from previous issue. Asterisks (or vertical lines) are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

MILITARY INTEREST:

CIVIL AGENCY COORDINATING ACTIVITIES:

Custodians

GSA-OPP, PCD

NASA-JFK

Army-MR

DOE-BPA

Navy-AS

Air Force-20

PREPARING ACTIVITY:

Review Activities

NAVY-AS

Army-MI, AT, ME, AR

DOD Project 9510-0416

Navy-SH

DLA-IS

User Activities

Navy-OS, YD, MC

Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain copies of documents referenced herein.

TABLE II. Chemical Composition, percent. 1/

Class	Carbon	Manganese	Phosphorus	Sulphur	Silicon	Chromium	Nickel	Molybdenum	Titanium	Columbium + tantalum	Aluminum	Nitrogen	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	0.75	----	----	----	0.10	0.75
304	0.08	2.00	0.045	0.03	1.00	18.0/ 20.0	8.0/ 10.5	0.75	----	----	----	0.10	0.75
304L	0.03	2.00	0.045	0.03	1.00	18.0/ 20.0	8.0/ 12.0	0.75	----	----	----	0.10	0.75
305	0.12	2.00	0.045	0.03	1.00	17.0/ 19.0	10.50/ 13.0	0.75	----	----	----	----	0.75
309	0.20	2.00	0.045	0.03	1.00	22.0/ 24.0	12.0/ 15.0	0.75	----	----	----	----	0.75
310	0.25	2.00	0.045	0.03	1.50	24.0/ 26.0	19.0/ 22.0	0.75	----	----	----	----	0.75
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	0.75
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	0.75
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	0.75
321	0.08	2.00	0.045	0.03	1.00	17.0/ 19.0	9.0/ 12.0	0.75	5x carbon min.	----	----	----	0.75
347	0.08	2.00	0.045	0.03	1.00	17.0/ 19.0	9.0/ 13.0	0.75	----	10x carbon min.	----	----	0.75
403	0.15	1.00	0.040	0.03	.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	----	----	----	----	----	----	----

TABLE II. Chemical Composition, percent. 1/ (continued)

Class	Carbon	Manganese	Phosphorus	Sulphur	Silicon	Chromium	Nickel	Molybdenum	Titanium	Columbium + tantalum	Aluminum	Nitrogen	Copper
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/ 27.00	----	----	----	----	----	0.25	----

1/ Single values are maximum values unless otherwise indicated.

TABLE III. Mechanical properties.

Classes	Condition (see 1.2.1.1)	Finish (see 1.2.1.3)	Diameter or thickness	Yield strength (min.) 0.2 percent offset	Ultimate tensile strength (min.)	Elongation in 2 ins. (min.)	Reduct. in area (min.)	Brinell hardness (max.) 5/
			Inches	P.s.i.	P.s.i.	Percent	Percent	
202, 302	A	Hot	1/2 and less	--	Max. 115,000	--	--	--
304, 309			Over 1/2	30,000	75,000 1/	40	50	--
310, 316,		Cold	1/2 and less	--	Max. 125,000	--	--	--
317, 321,			Over 1/2	30,000	75,000 1/	30	50	--
347	B	Cold	1/2 and less	--	125/155,000	--	--	--
202, 302			Over 1/2 to 3/4 incl.	100,000	125,000	12	35	--
304			Over 3/4 to 1 incl.	80,000	115,000	15	35	--
			Over 1 to 1-1/4 incl.	65,000	105,000	20	35	--
			Over 1-1/4 to 1-1/2 incl.	50,000	100,000	20	45	--
			Over 1-1/2 to 1-3/4 incl.	45,000	95,000	30	45	--
			Over 1-3/4	30,000	75,000	35	50	--
316, 317	B	Cold	1/2 and less	--	110/150,000	--	--	--
			Over 1/2 to 3/4 incl.	85,000	110,000	15	45	--
			Over 3/4 to 1 incl.	70,000	100,000	20	45	--
			Over 1 to 1-1/4 incl.	65,000	95,000	25	45	--
			Over 1-1/4 to 1-1/2 incl.	50,000	90,000	30	45	--
304L, 305,	A	Hot	1/2 and less	--	Max. 115,000	--	--	--
			316L	Over 1/2	25,000	70,000	45	50
403, 410	A	Hot	1/2 and less	--	Max. 115,000	--	--	--
			Over 1/2	--	--	--	--	241
		Cold	1/2 and less	--	Max. 115,000	--	--	--
	Over 1/2		--	--	--	--	241	
	T	Hot	1/2 and less	--	100/130,000	--	--	--
			Over 1/2	80,000	100,000	15	45	--

TABLE III. Mechanical properties. (continued)

Classes	Condition (see 1.2.1.1)	Finish (see 1.2.1.3)	Diameter or thickness	Yield strength (min.) 0.2 percent offset	Ultimate tensile strength (min.)	Elongation in 2 ins. (min.)	Reduct. in area (min.)	Brinell hardness (max.) 5/
				P.s.i.	P.s.i.	Percent	Percent	
403, 410	T	Cold	1/2 and less	--	100/130,000	--	--	--
			Over 1/2	88,000	100,000	12	40	--
	H	Hot	1/2 and less	--	120/150,000	--	--	--
			Over 1/2	90,000	120,000	12	40	--
		Cold	1/2 and less	--	120/150,000	--	--	--
			Over 1/2	90,000	120,000	12	40	--
405 2/	A	Hot	1/2 and less	--	Max. 100,000	--	--	--
			Over 1/2	--	--	--	--	207
		Cold	1/2 and less	--	Max. 105,000	--	--	--
Over 1/2	--		--	--	--	217		
414	A	Hot	1/2 and less	--	Max. 135,000	--	--	--
			Over 1/2	--	--	--	--	286
		Cold	1/2 and less	--	Max. 135,000	--	--	--
	Over 1/2		--	--	--	--	286	
	H	Hot	1/2 and less	--	120/150,000	--	--	--
			Over 1/2	100,000	120,000	15	45	--
Cold		1/2 and less	--	120/150,000	--	--	--	
	Over 1/2	100,000	120,000	12	40	--		
420 3/	A	Hot	1/2 and less	--	Max. 115,000	--	--	--
			Over 1/2	--	--	--	--	241
		Cold	1/2 and less	--	Max. 115,000	--	--	--
Over 1/2	--		--	--	--	241		
430	A	Hot	1/2 and less	--	Max. 100,000	--	--	--
			Over 1/2	35,000	65,000	20	50	--
		Cold	1/2 and less	--	Max. 110,000	--	--	--
Over 1/2	35,000		65,000	15	45	--		
440A 3/	A	Hot	1/2 and less	--	Max. 115,000	--	--	--
			Over 1/2	--	--	--	--	241
	Cold	1/2 and less	--	Max. 120,000	--	--	--	
		Over 1/2	--	--	--	--	25A	
440B 3/	A	Hot	1/2 and less	--	Max. 125,000	--	--	--
			Over 1/2	--	--	--	--	25B
	Cold	1/2 and less	--	Max. 130,000	--	--	--	
		Over 1/2	--	--	--	--	269	

TABLE III. Mechanical properties. (continued)

Classes	Condition (see 1.2.1.1)	Finish (see 1.2.1.3)	Diameter or thickness	Yield strength (min.) 0.2 percent offset	Ultimate tensile strength (min.)	Elongation in 2 ins. (min.)	Reduct. in area (min.)	Brinell hardness (max.) 4/
440C 3/	A	Hot	1/2 and less	---	Max. 135,000	--	--	--
			Over 1/2	---	--	--	--	269
446	A	Cold	1/2 and less	---	Max. 135,000	--	--	--
			Over 1/2	---	--	--	--	285
446	A	Hot	1/2 and less	---	Max. 105,000	--	--	--
			Over 1/2	---	--	--	--	223
446	A	Cold	1/2 and less	---	Max. 110,000	--	--	--
			Over 1/2	---	--	--	--	235

- 1/ A tensile strength of 70,000 p.s.i. minimum is acceptable for condition A extruded material.
- 2/ Material shall be capable of a maximum hardness as follows when oil quenched from 950°C. (1742°F.).
40S - 250BHN
- 3/ Material shall be capable of being heat treated to the following Rockwell hardness (minimum):
420 - C50
440A - C54
440B - C56
440C - C58
- 4/ Or equivalent Rockwell hardness.

QQ-S-763E

TABLE IV. Cross reference of corrosion resisting steel designations.

Federal designations		Military designations		Unified Numbering System
This specification	QQ-S-763A	46S18E	MIL-S-7720	
Class	Condition	Class and type	Class and type	Composition
202		---	---	S20200
302		---	---	302 S30200
302	A	1-D	1-B, 1-D	---
302	B	1-B, 1-C	1-C	---
304		---	---	S30400
304	A	1-A	1-A	---
304	B	---	---	---
304L		---	---	S30403
305		---	---	S30500
309		---	---	S30900
310		---	---	S31000
310	A	---	---	---
316		---	---	316 S31600
316	A	9-A	9-A	---
316	B	9-C	9-C	---
316L		---	---	S31603
317		---	---	S31700
321		---	8	S32100
321	A	8A	---	---
347		---	8	S34700
347	A	8A	---	---
403		---	---	S40300
405		---	---	S40500
410		---	---	S41000
410	A	---	3-A	---
410	A(hot. fin.)	3-A	---	---
410	A(cold. fin.)	3-C	3-C	---
410	T	3-E[1]	3-E	---
410	H	3-F	3-F	---
414		---	---	S41400
420		5-F[2]	---	S42000
420	A[3]	5-A	5A, 5F	---
430		---	4	S43000
430	A	4	---	---
440A		---	---	S44002
440B		---	---	S44003
440C		---	---	S44004
440C	A	10-A	---	---
446		---	---	S44600

[1] Not identical, but is an acceptable substitute.

[2] Shall be heat treated to Rockwell C50 minimum.

[3] This is not in the hardened condition corresponding to 5F (46S18E) but is required to be capable of being heat treated to Rc 50 minimum with a suitable stress relief. Parts should be hardened to the requirements of the drawing or as specified by the procuring activity.

INCH-POUND

QQ-S-763E
 AMENDMENT 1
 May 15, 1990

FEDERAL SPECIFICATION

STEEL BARS, WIRE, SHAPES, AND
 FORGINGS, CORROSION RESISTING

This amendment, which forms a part of QQ-S-763E, dated July 31, 1986, is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal Agencies.

Page 2

ADD: (to TABLE I)

Class	Condition			
	A Annealed	B Cold Worked high tensile	T Intermediate temper	H Hard Temper
UNS S30430	A	-	-	-
384	A	-	-	-

Page 8

Paragraph 3.12

ADD:

The annealing procedure for S30430 and 384 shall be in accordance with the table shown below, in addition to the requirements set forth in MIL-H-6875.

AISI or UNS Designation	Annealing treatment	
	Heating deg.F	Cooling
S30430	1850 to 2050	Water quench
384	1900 to 2100	Water quench

AMSC N/A

1 OF 3

FSC 9510

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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ADD: (to TABLE II)

Class	Carbon	Man- ganese	Phos- phorus	Sulfur	Silicon	Chrom- ium	Nickel	MoLyb- denum	Titan- ium	Columbium & Tantalum	Alum- inum	Nitrogen	Copper
UNS S30430	0.03	2.00	0.045	0.03	1.00	17.0/ 19.0	8.0/ 10.0	---	---	---	---	---	3.0/ 4.0
384	0.04	2.00	0.045	0.03	1.00	15.0/ 17.0	17.0/ 19.0	---	---	---	---	---	0.75

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ADD: (to TABLE III)

Class	Condition (see 1.2.1.1)	Finish (see 1.2.1.3)	Diameter or thickness inches	Yield strength 0.2 percent offset (min.) psi	Ultimate tensile strength (min.) psi	Elongation in 2 inches (min.) percent	Reduction in area (min.) percent	Brinell hardness
UNS S30430	A	Hot	0.5 or less	---	(max) 115,000	---	---	---
			over 0.5	25,000	65,000	60	70	---
384	A	Cold	0.5 or less	---	(max) 115,000	---	---	---
			over 0.5	30,000	70,000	65	80	---
384	A	Hot	0.5 or less	---	(max) 115,000	---	---	---
			over 0.5	25,000	70,000	50	75	---
384	A	Cold	0.5 or less	---	(max) 115,000	---	---	---
			over 0.5	25,000	70,000	50	75	---

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Paragraph 6.1.1.2

DELETE: (Entire paragraph)

ADD: Classes 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.

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ADD: (to TABLE IV)

Federal designations		Military designations		Unified Numbering System
This specification	QQ-S-763A	46S18E	MIL-S-7720	
Class	Condition	Class and type	Class and type	Composition
XM-7[4]	A	---	---	---
384	A	---	---	---
				S30430
				S38400

[4] XM-7 is no longer used as the AISI designation. The correct designation to be used is the Unified Numbering System designation S30430.

MILITARY INTEREST:

Custodians

Army-MR
Navy-AS
Air Force-11

Review Activities

Army-MI, AT, ME, AR
Navy-SH
DLA-IS

User Activities

Navy-OS, YD, MC

CIVIL AGENCY COORDINATING ACTIVITIES:

GSA-FSS
NASA-JFK
DOE

PREPARING ACTIVITY:

NAVY-AS

DOD Project 9510-0719