

**QQ-W-405b**

February 11, 1966

**SUPERSEDING**

Fed. Spec. QQ-W-405a

April 27, 1960 and

Fed. Spec. QQ-W-409a

January 19, 1960

**FEDERAL SPECIFICATION****WIRE, STEEL, CARBON AND ALLOY, (FOR COLD  
HEADING AND COLD FORGING)**

*This specification was 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 round, carbon- and alloy-steel wire for cold heading and cold forging in the manufacture of fasteners such as bolts, nuts, rivets, and screws. The wire covered by this specification is not intended for high strength fasteners when decarburization limits are more stringent than the limits of table II.

**1.2 Classification.**

1.2.1 Composition. Steel composition of carbon- and alloy-steel wire shall conform to the requirements of Fed. Std. No. 66, based on the numbering system indicated in table I, as specified in the contract or order (see 6.2).

**TABLE I. Carbon and alloy steel numbers**

Common name	Steel No.	Common name	Steel No.
Low-carbon steel	1006	Nickel-chromium steel	3120
	1008		3120
	1010		3135
	1012		3140
Medium low-carbon steel	1013	Molybdenum steel	4023
	1015		4027
	1016		4037
	1017		4042
	1018	Chromium-molybdenum steel	4130
	1019		4135
	1020		4137
Medium high-carbon steel	1022		4140
	1024		4142
	1025	Nickel-molybdenum steel	4615
	1027		4640
	1030		

Common name	Steel No.	Common name	Steel No.
Medium high-carbon steel (cont'd)	1033	Chromium steel	5120
	1034		5130
	1035		5132
	1038		5135
	1040		5140
	1041		
Resulfurized steel	1108	Manganese-chromium-vanadium steel	6120
	1109		8620
	1110		8630
Manganese steel	1830	Nickel-chromium-molybdenum steel	8637
	1835		8640
	1840		8720
			8735
			8740

**1.2.2 Conditions.**

(a) Carbon-steel wire shall be of the following conditions as specified (see 6.2):

- 1—Wire drawn from hot-rolled coils.
- 2—Wire drawn from annealed or spheroidize-annealed, hot-rolled coils.
- 3—Wire annealed in process.
- 4—Wire spheroidize-annealed in process.
- 5—Wire spheroidize-annealed at finished size.
- 6—Wire drawn from normalized hot rolled rods.
- 7—Wire annealed at finished size.

(b) Alloy-steel wire shall be of the following conditions, as specified (see 6.2):

- 8—Wire drawn from spheroidize-annealed, hot-rolled coils.

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- 9—Wire drawn from annealed or normalized hot-rolled coils and spheroidize-annealed in process.
- 10—Wire drawn from annealed or normalized hot-rolled coils and spheroidize-annealed at finished size.

**1.2.3 Finishes.** Carbon- and alloy-steel wire shall have the following finishes, as specified (see 6.1.3 and 6.2):

- 1—Regular bolt wire finish.
- 2—Single extrusion finish.
- 3—Double extrusion finish.
- 4—Phosphate finish.

A finish other than that indicated in 1.2.3 shall be specified or shall be agreed upon between the supplier and the purchaser (see 6.2).

**1.2.4 Sizes.** The wire shall be furnished to the sizes (diameters), specified in the invitation for bids, contract, or order (see 6.2).

## 2. APPLICABLE STANDARDS

2.1 The following standards, of the issues in effect on date of invitation for bids or request for proposal, 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. 102—Preservation, Packaging, and Packing Levels.
- Fed. Std. No. 123—Marking for Domestic Shipment (Civilian Agencies).
- Fed. Test Method Std. No. 151—Metals; Test Methods.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S.

Government Printing Office, Washington, D. C. 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, and Seattle, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

### *Military Standards:*

MIL-STD-129—Marking for Shipment and Storage.

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

(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.)

## 3. REQUIREMENTS

3.1 Material. The wire shall be carbon- or alloy-steel of the specified composition.

### 3.2 Chemical requirements.

**3.2.1 Ladle analysis.** Unless otherwise specified (see 6.2), a ladle analysis of each heat or lot of steel, from which the furnished wire is made, shall be supplied by the contractor. The analysis of the furnished wire shall conform to the specified composition as given in tables 3, 4, and 18 of Fed. Std. No. 66, as applicable.

**3.2.2 Check analysis.** When specified (see 4.5.2 and 6.2), a check analysis shall be performed on the wire. The chemical composition of the steel in the furnished wire, as determined by a check analysis, shall meet the requirements set forth in tables 11 and 20 of Fed. Std. No. 66, as applicable.

3.3 Condition and quality. Wire shall be

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of such condition and quality that it will comply with the cold upsetting test specified in 4.5.4. When specified (see 6.2), wire shall be suitable for the manufacture of a particular part, in lieu of complying with the cold upsetting test.

**3.4 Decarburization.** Unless otherwise specified (see 6.2), the wire with minimum specified content of carbon of 0.28 percent and up shall not show decarburization greater than that shown in table II for the size of the furnished wire.

TABLE II. Decarburization limits

Wire size (diameter)		Average depth free ferrite, maximum	Average total affected depth (free ferrite plus partial decarburization), maximum
Over	Up to		
<i>Inch</i>	<i>Inch</i>	<i>Inch</i>	<i>Inch</i>
1/2	3/4 incl.	0.005	0.014
3/8	1/2 incl.	.004	.012
—	3/8 incl.	.003	.010

**3.5 Finish.** The finish of the furnished wire shall be as specified (see 6.2), and shall be uniform throughout the entire lot.

### 3.6 Dimensional requirements.

**3.6.1 Wire size (diameter).** The size of the furnished wire shall be as specified and shall not vary by more than the amount given in tables 17a1 and 17b1 of Fed. Std. No. 48 as applicable. When specified (see 6.2), wires with closer diameter tolerances shall be supplied.

**3.6.2 Length.** Wire shall be of one continuous length without joints of any kind, except when approval has been negotiated to permit welded coils.

**3.6.3 Coils.** Wire shall be supplied in coils of the approximate inner diameter and of full or split catchweights, as specified (see 6.2 and 6.3).

**3.7 Identification marking.** Unless otherwise specified (see 5.2 and 6.2), each wire coil shall carry an oilproof cardboard tag

marked with indelible ink or a metal tag stamped with the following information:

Federal Specification Symbol: QQ-W-405b  
Wire, • Steel: Composition, Condition and Finish Numbers

Wire size

Manufacturer's name, or readily identifiable trademark or symbol

Name of the contractor (if different from manufacturer)

Heat Number

\* Insert "Alloy" or "Carbon", as applicable.

**3.7.1** For wires of size 0.250 inch or smaller, the oilproof cardboard tag or the metal tag, as applicable, shall be attached to the starting end of the coil.

**3.8 Workmanship.** Wire shall be uniform in chemical composition, free of undue segregation, of adequate internal soundness, in corrosion-free condition, and lacking injurious laps, scratches, seams, etc., which may impair use for purposes of cold heading or forging.

## 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.** Unless otherwise specified (see 6.2), a lot shall consist of all wire submitted for inspection at the same time, for the same order, of the same composition, condition, finish, and size, and manufactured by the same process from steel of the same heat.

**4.3 Sampling.** From each lot, not more than

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five percent of the coils in the lot shall be selected at random for inspection and tests.

### 4.4 Inspection.

**4.4.1 Inspection for dimensional and marking requirements.** Each sample coil shall be visually inspected for dimensional and marking requirements and the wire shall be measured or gaged at three places (one near each end and one near the middle of the coil). If any sample coil does not conform to the dimensional and marking requirements, the lot shall be rejected.

### 4.5 Test.

**4.5.1 Test samples.** From each sample coil (see 4.3), a test sample of a sufficient length shall be taken. Each test sample shall be identified by the sample coil and lot numbers.

**4.5.2 Chemical (check) analysis.** When specified (see 3.2.2 and 6.2), the check analysis shall be the responsibility of the purchaser.

One test specimen for a check analysis shall be prepared from each lot. The test specimen shall consist of not less than 2 ounces of fine shavings, cuttings, or millings obtained from the entire cross section of the test samples. The test specimen shall be free from oil, dirt, and any other foreign matter. The chemical test shall be made either by a wet chemical or by a spectrographic method in accordance with methods 111 and 112 of Fed. Test Method Std. No. 151. In case of dispute, an analysis by a wet chemical method shall be the basis of acceptance or rejection.

**4.5.3 Decarburization test.** The test specimens (see 4.5.1), selected at random, shall be examined microscopically at a magnification of 100 diameters for compliance with the requirements stated in 3.4 and in table II.

**4.5.4 Upsetting test.** From the test specimens (see 4.5.1), selected at random, a test piece shall be cut, each having a length of one and one fourth times the diameter of wire. This test piece shall withstand cold

upsetting (compression) in a longitudinal direction of 60 percent of original length without showing cracks, seams, or other defects which would produce injurious defects in the articles made from the wire.

**4.5.5 Part fabrication.** Upon approval of the contracting officer or when specified (see 6.2), wire shall be subjected to fabrication tests as specified in lieu of the cold upsetting test in 4.5.4.

**4.6 Rejection and retest.** If a test specimen fails to meet any test requirement of this specification, the lot represented by the specimen shall be rejected. Retests shall be permitted in accordance with the General Section of Fed. Test Method Std. No. 151.

**4.7 Inspection of preparation for delivery.** The preservation, packaging, packing, and marking of the wire shall be examined to determine compliance with the requirements of section 5.

## 5. PREPARATION FOR DELIVERY

(For civil agency procurement, the definitions and application of levels of packing shall be in accordance with Fed. Std. No. 102.)

**5.1 Preservation, packaging, and packing.** The wire shall be preserved, packaged, and packed for each level of protection in accordance with MIL-STD-163.

**5.2 Marking.** Unless otherwise specified (see 6.2), when wire coils are shipped loose in fiber drums or in boxes, each loose coil, fiber drum, or box in the shipments shall be marked in accordance with MIL-STD-163 and shall carry an oilproof cardboard or metal tag that is indelibly inked or stamped with the following information:

Federal Specification symbol: QQ-W-405b  
Wire, \* Steel; Composition, Condition  
and Finish numbers

Size of wire

Name of the contractor

Contract or order number

Name and address of consignee

\* Insert "Alloy" or "Carbon", as applicable.

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**5.2.1 Civil agencies.** In addition to markings required by the contract or order, the shipping containers shall be marked in accordance with Fed. Std. No. 123.

**5.2.2 Military activities.** In addition to markings required by the contract or order, the shipping containers shall be marked in accordance with MIL-STD-129.

## 6. NOTES

**6.1 Intended use.** The specified round carbon-steel and alloy-steel wires are intended for use in the manufacture by cold heading and cold forging of machine bolts, nuts, rivets, screws (cap, set, sheet metal, wood).

**6.1.1 Compositions.** Cold-heading characteristics of alloy-steel wires are somewhat lower than those of plain carbon-steel wires. In alloy-steels of the same general chemical composition, those with a low carbon content have better heading characteristics than those with a high carbon content. The selection of a steel-wire composition for cold heading depends on the shape of the article to be produced, the work load it will carry, and the heat treatment, if any, to which it may be subjected.

**6.1.1.1 Cold-headed articles made of compositions from No. 1006 through No. 1012** can be casehardened only, while those of compositions No. 1013 and up may be either casehardened or heat treated. When grades of steel are to be casehardened, these steels should be produced as killed steels.

**6.1.1.2 Cold-heading characteristics of carbon-steel wires of the same condition and finish** may be generally graded by their composition numbers, as follows:

Excellent: Steel No. 1006 through Steel No. 1012

Good: Steel No. 1013 through Steel No. 1038

Fair: Steel Nos. 1040, 1041, 1108, 1109, and 1110

**6.1.2 Conditions.** The selection of a condi-

tion in wires for heading work in the processing of carbon-steel wire are presented below in approximate terms. The information given is subject to variations because of the specific shape and character of the work to be done, the construction of the dies used, and the type and pressure capacity of the headers to be used. The information is adequate for general classification or as a guide, but should not be used without more detailed knowledge of the specific end product.

Wire conditions	Heading work		
	Light	Average	Heavy
	Steel compositions		
1 .....	1006 to 1010	.....	.....
2 .....	.....	1012 to 1017	.....
3 .....	.....	1018 to 1027	1006 to 1017
4 .....	.....	1030 to 1041	1018 to 1027
5 .....	.....	.....	1030 to 1041

Resulfurized steel wires are used for light heading work; wood screws and similar articles only.

**6.1.2.1** For light cold-heading or forging work in the processing of alloy-steel wire, wires in condition 8 are used. For severe cold-heading or forging work, wires of either condition 9 or 10, as applicable, are used.

**6.1.3 Finishes.** Steel wire for cold-heading and forging work are provided with suitable (or specified) finishes to assure proper lubrication and prevent galling and unnecessary wear of the dies. The selection of the finishes and of the lubricants depends on the wire condition, the character of the work to be done, the type of the header, and the design of the dies.

**6.1.4** For additional information, refer to SAE J429a, Mechanical and Chemical Requirements for Threaded Fasteners.

**6.2 Ordering data.** Purchasers should exercise any desired options offered herein and procurement documents should specify the following:

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

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- (b) Composition and condition (see 1.2.1 and 1.2.2).
- (c) Finish, as required (see 1.2.3 and 1.2.3.1).
- (d) Size (diameter) of wire (see 1.2.4 and 3.6.1).
- (e) Check analysis, if required (see 3.2.2 and 4.5.2).
- (f) Total weight, in lbs., of wire.
- (g) Coil: Approximate weight and inside diameter (see 3.6.3 and 6.2).
- (h) Drawing or print of the part to be produced should be furnished on all procurement documents.
- (i) When part fabrication test is to be used in lieu of upsetting test (see 3.3 and 4.5.4).
- (j) When the wire coils shall be shipped loose, boxed, or packed in fiber drums (see 5.2).
- (k) Levels of preservation, packaging, and packing required (see 5.1).
- (m) Purchasers may also exercise any desired options offered herein (see 1.2, 3.2.1, 3.4, 3.6.1, 3.7, 4.1, 4.2, 5.1, and 5.2).

## 6.3 Coils and catchweight coils.

6.3.1 Steel wires are commercially available in coils of the following inside coil diameters:

Wire size (diameter)	Approximate inside coil diameters
<i>Inches</i>	<i>Inches</i>
From 1/8 to 3/16 .....	17 to 22
From 3/16 to 1/2 .....	22 to 28
From 1/2 to 3/4 .....	28 to 36

6.3.2 The weight of a full catchweight wire coil is variable and depends on the weight of the original wire-rod coil, the capacity of the wire drawing equipment in the wire mill, and the diameter of the finished wire. Full

catchweight coils are therefore cut into split catchweight coils which for heading work generally contain 100 to 500 pounds of wire. On orders of a specific weight, not more than 10 percent of all ordered coils may be of a lighter weight.

6.4 Transportation descriptions. The transportation descriptions and minimum weights applicable to this commodity are:

**Rail:**

Wire, steel, plain.

Carload minimum weight 40,000 pounds.

**Motor:**

Wire, steel, plain.

Truckload minimum weight 40,000 pounds, subject to Rule 115, National Motor Freight Classification.

**MILITARY CUSTODIANS:**

Army—MR

Navy—YD

Air Force—69

**Review activities:**

Army—MR, MU

Navy—YD, SH

Air Force—69

**User activities:**

Army—ML, WC, MO

Navy—CG

Air Force—None

**Preparing activity:**

Navy—YD

Review/user information is current as of the date of this document. For future coordination of changes to this document, draft circulation should be based on the information in the current DOD Standardization Documents.

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 extra copies and other documents referenced herein. Price 5 cents each.



SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 119-R004
<p align="center"><b>INSTRUCTIONS</b></p> <p>This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).</p>		
SPECIFICATION		
QQ-W-405b - Wire, Steel, Carbon and Alloy (For Cold Heading and Cold Forging)		
ORGANIZATION (of submitter)		CITY AND STATE
CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
MATERIAL PROCURED UNDER A		
<input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CAUSED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?		
A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE?		
<input type="checkbox"/> YES <input type="checkbox"/> NO IF "YES", IN WHAT WAY?		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity)		DATE