

QQ-W-412**APRIL 7, 1959****SUPERSEDING****Fed. Spec. QQ-W-474a (In Part)****April 21, 1948****(See 6.3)****FEDERAL SPECIFICATION****WIRE, STEEL, ALLOY (GENERAL PURPOSE QUALITY),
FOR MECHANICAL SPRINGS**

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 two compositions, each of two types, of uncoated, round (0.020 to 0.500 inches in. diameter) alloy-steel wire for the manufacture of mechanical springs subjected to mildly elevated temperatures (see 6.1).

1.2 Classification.

1.2.1 Compositions. — Spring steel wire shall be of the following compositions as specified (see 6.3):

Composition 1.—Chromium-vanadium.

Composition 2.—Chromium-silicon.

1.2.2 Types.—The wire shall be of the following types, as specified:

Type I.—Oil tempered wire for the manufacture of springs which require no subsequent hardening.

Type II.¹—Soft wire for the manufacture of springs which are to be hardened after cold forming, furnished in two conditions, as follows:

Condition A.—Spheroidize annealed at finished size.

Condition B.—Spheroidize annealed and lightly drawn.

¹ If a condition letter is not specified for type II wire, either condition A or B may be selected at the option of the spring manufacturer.

2. APPLICABLE STANDARDS

2.1 The following standards, of the issues in effect on the date of invitation for bids, form a part of this specification:

Federal Standards:

Fed. Std. No. 48—Tolerances for Steel and Iron Wrought Products.

Fed. Std. No. 66—Steel: Chemical Composition and Hardenability.

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, Standards, and Handbooks 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 25, D. C.)

(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, Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C.)

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

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Military Standards:**MIL-STD-163 — Preparation of Steel Products for Domestic Shipment (Storage) and Overseas Shipment.**

(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 Manufacturing process. — The steel shall be manufactured by the open-hearth or electric-furnace process. Sufficient discard shall be taken from each ingot to insure freedom from injurious piping and segregation.

3.2 Chemical composition.—The composition of the steel shall be as shown in table I, subject to the check analysis tolerances given in the applicable table of Federal Standard No. 66.

3.3 Surface. — Wire shall be free from cracks, rust, excessive decarburization, and injurious seams, pits, die marks, scale, or other injurious defects.

TABLE I.—Chemical composition (ladle analysis)

Elements	Composition 1 (chromium- vanadium)	Composition 2 (chromium- silicon)
	<i>Percent</i>	<i>Percent</i>
Carbon -----	0.45 to 0.55	0.50 to 0.60
Manganese -----	.70 to .90	.50 to .80
Phosphorus ----	.040 max.	.040 max.
Sulphur -----	.040 max.	.040 max.
Silicon -----	.20 to 0.35	1.20 to 1.60
Chromium -----	.80 to 1.10	0.50 to 0.80
Vanadium -----	.15 min. ¹	-----

¹ Desired vanadium content, 0.18 percent.

3.4 Dimensions.—The wire shall be of the size specified, subject to the tolerances given in table 17b2 of Federal Standard No. 48 for Alloy Steel Spring Wire.

3.4.1 Out-of-round.—The wire shall not be out-of-round by more than one-half the total permissible variation in diameter specified in table 17b2 of Federal Standard No. 48.

3.5 Wrapping requirement.—Wire shall be free from surface breaks or cracks after wrapping as specified in 4.6.3.

3.6 Tensile requirements.

3.6.1 Type I.—Type I wire shall conform to the tensile requirements shown in table II.

3.6.2 Type II.

3.6.2.1 Condition A.—The wire shall be spheroidize annealed at finished size and shall have no cold work in the finished condition. The maximum tensile strength shall be 100,000 p.s.i. for all compositions.

3.6.2.2 Condition B.—The wire shall be spheroidize annealed and shall be given at least one pass through dies after the last spheroidize annealing treatment. The tensile strength shall be 105,000 to 140,000 p.s.i. for all compositions.

3.7 Workmanship.—The wire shall be uniform in quality and temper. Each bundle shall be one continuous length of wire, properly coiled, and firmly tied. Type I wire and type II, condition B wire shall not be wavy or kinked.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 Unless otherwise specified herein, the supplier is responsible for the performance of all inspection requirements prior to submission for Government inspection and acceptance. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. Inspection records of the examinations and tests shall be kept complete and available to the Government as specified in the contract or order.

TABLE II.—*Tensile strength, type 1 wire*

Diameter ¹	Composition 1 (chromium-vanadium)		Composition 2 (chromium-silicon)	
	Minimum	Maximum	Minimum	Maximum
<i>Inch.</i>	<i>P.s.i.</i>	<i>P.s.i.</i>	<i>P.s.i.</i>	<i>P.s.i.</i>
0.500 -----	190,000	210,000	-----	-----
.437 -----	195,000	215,000	235,000	260,000
.375 -----	200,000	220,000	240,000	265,000
.312 -----	203,000	223,000	245,000	270,000
.283 -----	205,000	225,000	248,000	273,000
.250 -----	210,000	230,000	250,000	275,000
.192 -----	220,000	240,000	260,000	285,000
.162 -----	225,000	245,000	265,000	290,000
.135 -----	235,000	255,000	270,000	295,000
.105 -----	245,000	265,000	275,000	300,000
.093 -----	250,000	270,000	280,000	305,000
.080 -----	255,000	275,000	285,000	310,000
.072 -----	260,000	280,000	288,000	313,000
.062 -----	265,000	290,000	290,000	315,000
.048 -----	280,000	305,000	295,000	320,000
.035 -----	290,000	315,000	300,000	325,000
.020 -----	300,000	325,000	-----	-----

¹ For diameters other than those shown in table II, tensile strength shall be determined by interpolation.

4.2 Government inspection.—The Government inspector will make such inspections as are necessary to determine that the wire is in accordance with requirements of the contract or order and this specification.

4.3 Lot.—A lot shall consist of wire of the same size, type, composition, and condition manufactured from the same heat of steel and submitted for inspection at the same time.

4.4 Sampling.

4.4.1 Sampling for chemical tests.—Three separate sample specimens for Government analysis shall be taken from wire representing, where possible, the first, middle, and latter third of the heat or of such subportion of the heat as comprises the lot. Sample specimens shall be milled or cut from the entire cross section of the wire.

4.4.2 Sampling for examination and mechanical tests.—Seven sample coils or ten

percent of the coils, whichever is less, shall be selected at random from each lot. Specimens shall be taken from one end of each sample coil for tensile and wrapping tests.

4.4.3 Sampling for packaging, packing, and marking.—Seven sample containers or ten percent of the containers, whichever is less, shall be selected at random from each lot for the inspection of 4.5.2.

4.5 Examination. — The sample coils selected in accordance with 4.4.2 shall be visually and dimensionally examined to determine conformance to the surface requirements of 3.3, the dimensional requirements of 3.4, and the workmanship requirements of 3.7.

4.5.1 Dimensions.—Each coil selected in accordance with 4.4.2 shall be dimensionally examined in three places for conformance to 3.4. If practicable, one measurement shall be taken at each end of the wire and one near the middle. Otherwise three examinations

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shall be made between two and twelve feet from one end of the coil.

4.5.2 Preservation, packaging, packing, and marking.—The inspector shall ascertain that preservation, packaging, and packing of the wire and marking of containers selected in accordance with 4.4.3 is in accordance with the requirements of this specification and the contract or order.

4.6 Tests.

4.6.1 Chemical tests.—Chemical tests shall be made in accordance with Federal Test Method Standard No. 151, method 111. The samples shall be analyzed for conformity with 3.2.

4.6.2 Tensile test.—The tensile test shall be made in accordance with Federal Test Method Standard No. 151, method 211. The test specimen shall be straight, and the length of the specimen between the jaws of the testing machine shall not be less than 10 inches.

4.6.3 Wrapping test.—Wire small enough to be wrapped by hand may be tested by bending one end of the wire over itself to form a loop with ends crossed at right angles, the shorter end being several inches long, and then tightly winding the longer end five complete turns about the other with turns close together. For larger wire, or optionally on wire of any size, the wrapping may be done on a power device which will wrap the wire closely about a mandrel of the diameter specified in table III, for five complete turns. The specimen shall be considered to have failed if any cracks occur in the wire after the first complete turn. If a crack occurs during the first turn, the test shall be discontinued, due to the uncertainty regarding the radius of the first turn, and an additional specimen shall be tested.

4.6.4 Out-of-round test.—The sample coils shall be gaged for roundness at three well separated locations by measuring the diam-

TABLE III.—Mandrel size for wrapping test

Wire diameter ¹	Diameter of mandrel
Inch	Inch
0.020 to 0.162 -----	Equal to diameter of wire
0.163 to 0.312 -----	Twice the wire diameter

¹ Unless otherwise specified, the wrapping test shall not be required for wire over 0.312-inch diameter.

eter twice at the same location 90° apart. A coil shall be considered nonconforming if any two measurements at the same location do not comply with the requirements of 3.4.1.

4.7 Rejection and resubmission.—Should any sample unit or specimen fail to comply with the requirements specified herein, the lot shall be subject to rejection. The lot may be resubmitted for inspection, provided the contractor has removed defective material or reworked the lot.

5. PREPARATION FOR DELIVERY

5.1 Level A.—Unless otherwise specified in the contract or order (see 6.2), material shall be preserved, packaged, and packed in accordance with requirements of MIL-STD-163.

5.2 Level C.—Material shall be prepared for shipment in accordance with commercial practice to ensure carrier acceptance for safe delivery to the destination at the lowest rate. As a minimum, the shipment shall meet the requirements of carrier rules and regulations applicable to the mode of transportation.

5.3 Marking.—In addition to any special marking required by the contract or order, marking shall be in accordance with requirements of MIL-STD-163.

6. NOTES

6.1 Intended use.—Wire covered by this specification is intended particularly for springs subjected to temperatures not exceeding 450°F. Composition 2 is considered somewhat superior to composition 1 for re-

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TABLE IV.—*Equivalent materials*

Superseded designation	Current designation
QQ-W-465a:	
Class A.—Spring -----	QQ-W-428, type II.
Class B.—Zinc-coated high strength -----	Not covered (obsolete). Refer to cognizant procuring activity.
QQ-W-474a:	
Compositions A and B. —Oil tempered -----	QQ-W-428, type I.
Composition C.— Annealed -----	Not covered. Refer to cognizant procuring activity. Type III of QQ-W-428 is suggested as a replacement.
Composition D.— Annealed -----	QQ-W-412, composition 1, type II.
Compositions E and F. —Annealed -----	Not covered. Refer to cognizant procuring activity. Composition 2, type II of QQ-W- 412 is suggested as a replacement.

sistance to permanent set under load at elevated temperatures. When spring wire is required to have extra high-fatigue resistance, aircraft-quality alloy-steel spring wire, entirely free from surface defects and decarburization, should be used.

6.1.1 Type I.—Type I wire is intended for fabrication into springs which require no subsequent heat treatment except low-temperature stress relief.

6.1.2 Type II.—Type II wire is a soft wire intended for fabrication of springs where forming operations are too severe for type I wire. Type II wire should be hardened after forming.

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.
- (b) Composition number (see 1.2.1).
- (c) Type of wire (see 1.2.2).
- (d) Size of wire (see 3.4).
- (e) Quantity of wire.
- (f) Level of packaging (see 5.1 and 5.2).
- (g) For type II wire, the condition letter (see footnote under 1.2).
- (h) Marking if different from 5.3.

6.3 Supersession data.—Supersession data for materials covered by Federal Specifications QQ-W-465a and QQ-W-474a is included in table IV.

6.4 Transportation description.—Transportation description applicable to this item is as follows:

Wire, steel, acid covered, galvanized, painted, plain or tinned.

Carload minimum weight 40,000 pounds.

Motor volume minimum weight 36,000 pounds.

Notice. — When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

MILITARY INTERESTS:

Army—O
Navy—Or
Air Force.