Downloaded from http://www.everyspec.com

MIL-S-46049C
6 February 1987
SUPERSEDING
MIL-S-46049B(MR)
9 November 1976

MILITARY SPECIFICATION

STRIP, METAL, CARBON STEEL, COLD ROLLED, HARDENED AND TEMPERED SPRING QUALITY

This specification is approved for use by the U.S. Army Materials Technology Laboratory, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense,

1. SCOPE

1.1 This specification covers cold rolled carbon steel of hardened and tempered spring quality in strip form for use in spring applications.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DOCISS) and eupplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which nag be of use in improving this dooumont should be addressed to: Director, US Army Laboratory Command, Materials Technology Laboratory, ATTN: SLCMT-MSE, Watertown, MA 02172-0001 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

/FSC 9515/

DISTRIBUTION STATEMENT A Approved for Public Release; Distribution Unlimited.

Downloaded from http://www.everyspec.com

SPECIFICATIONS

MILITARY

MIL-L-3150 - Lubricating Oil, Preservative, Medium

STANDARDS

FEDERAL

FED-STD-66 - Steel: Chemical Composition and Hardenability

MILITARY

MIL-STD-129 - Marking for Shipment and Storage
MIL-STD-163 - Steel Mill Products Preparation for Shipment and Storage

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the iasue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

ASTM A109 - Specification for Steel, Carbon, Cold-Rolled Strip
ASTM A751 - Methods, Practices, and Definitions for Chemical Analysis of Steel Products
ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell iiardness and Rockwell Superficial Hardness of Metallic Materials

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

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

Downloaded from http://www.everyspec.com

3. REQUIREMENTS

3.1 Type of steel. The steal shall be produced from fully killed steel to which sufficient aluminum has been added to produce a fine austenitfc grain.

3.2 Chemical composition. Chemical composition of the steel may be ordered to identification numbers or applicable ranges. or maximum or minimum limits (see 6.1 and 5.2). The supplier shall submit a chemical analysis of each heat of steel to the procuring activity.

3.2.1 Product analysis. The chemical composition, as determined by product analysis, shall meet the requirements for the specified composition provided that in a heat of steel the individual tolerances do not vary from above and below the ranges shown for product analysis tolerances in FED-STD-66. This product analysis, if required, shall be preformed by the producer.

3.3 Mechanical properties.

3.3.1 Hardness. The steel, hardened and tempered, shall meet the hardness requirements specified on drawings or in the invitation for bids, contract, or order (see 6.1). Specified hardness ranges shall be as shown in table I unless otherwise negotiated between the supplier and the procuring activity.

3.3.2 Tensile strength (0.006 inch (0.203mm) thick and under). Ultimate tensile strength shall be as shown in table I.

3.3.3 Cold bending, If the strip is subject to other than minor bending, the requirements, limits and method of conducting the bend test shall be negotiated between the contractor and procuring activity.

3.4 Decarburization. The maximum permissible depth of total and partial decarburization of the strip shall be 0.001 inch (0.025mm) or 1.5% of the thickness of the strip, whichever depth is greater,

3.5 Finish. Unless otherwise specified in the invitation for bids, contract, or order, strip shall be furnished with a scaleless tempered finish (see 6.1 and 6.3).

3.6 Edge. The strip shall be furnished with a No. 1 edge (in accordance with ASTM A109) free from waves, cracks, and excessive burrs.

3.7 Dimensions. The strip shall be furnished in the sizes as specified in the invitation for bids, contract, or order (see 6.1). Tolerances from specified dimensions shall be as shown in accordance with tables 5, 6, 9 and 10 of ASTM A109 or ASTM A109M for values corresponding to a Number 1 edge. No flatness tolerances have been formulated and, when required, flatness tolerances for specified sizes should be negotiated between the supplier and the procuring activity.

3.8 Identification marking. Unless otherwise specified in the contract or order (see 6.1), strip in coils or bundles of cut lengths shall have the manufacturer's name or trademark, the specification number and type legibly imprinted on oilproof, waterproof tags. One tag shall be attached to each coil or bundle.

Downloaded from http://www.everyspec.com

TABLE I. Cold rolled carbon spring steel. hardened and tempered. Limits of Rockwell hardness ranges and tensile strength ranges.

Thickness, Inch	Mechanical Property	Per Cent Carbon, Maximum 0.60	0.70	0.80	0.90	1.00	1.05
		Limits of Mechanical Property Ranges a/					
>0.120 (3.05)	Rockwell C hardness	34.0-42.0	36.0-44.0	38.0-46.0	40.0-48.0	42.0-50.0	43.0-51.0
0.100 - 0.119 (2.54 - 3.02)	Rockwell C hardness	35.0-43.0	37.0-45.0	39.0-47-0	41.0-49.0	43.0-51.0	44.0-52.0
0.080 - 0.099 (2.03 - 3.51)	Rockwell C hardness	36.0-44.0	38.0-46.0	40.0-48.0	42.0-50.0	44.0-52.0	45.0-53.0
0.060 - 0.079 (1.52 - 2.01)	Rockwell C hardness	36.5-44.5	38.5-46.5	40.5-48.5	42.5-50.5	44.5-52.5	45.5.53.5
0.040 - a.059 (1.02 - 1.50)	Rockwell. C hardness	37.5-45.5	39.547.5	41.5-49.5	4X5-51.5	45.5-53.5	46.5-54.5
0.070 - 0.039 (0.762 - 1.00)	Rockwell 30-N hardness	57.0 -65.0	59.0-67.0	60.5-68.5	62.5-70.5	64.0-72.0	65-O-735.0
0.020 - 0.029 (0.508 - 0.737)	Rockwell 30-N hardness	57.0-65.5	59.5-67.5	61.0 -69.0	63.0-71.0	64.5-72.0	65.5-73.5
0.010 - 0.019 (0.254 - 0.483)	Rockwell 15-N hardness	79.0-84.0	80.0-85.0	81.0-86.0	62.0-87.0	83.0-88.0	83.5-88.5
0.005 - 0.009 (0.127 - 0.224)	U.T.S. b/, ksi (MPa)	175-255 (1207-1758)	190-270 (1310-1862)	205-285 (1413-1965)	225-305 (1551-2103)	245-325 (1689-2041)	255-335 (1758-2310)

a/ Mechanical property requirements within the above ranges for each grade of hardened and tempered cold rolled carbon spring steel are as follows:

Mechanical Property	Standard Range
Rockwell C hardness	Any 4 points
Rockwell 30-N hardness	Any 4 points
Rockwell 15-U hardness	Any 3 points
Ultimate tensile strength	Any 20 koi (137.9 MPa)

b/ These ultimate tensile strength values apply only to a thickness 0.008 inch (0.203mm) and below.

Downloaded from http://www.everyspec.com

3.9 Workmanship. The steel shell be clean and free of imperfections such as laminations, segregation and surface defects as is consistent with good commercial practice for this steel quality.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by 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 supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Lot. Unless otherwise specified in the contract or order (see 6.1), a lot shall consist of all steel submitted for inspection et one time, of the same heat, the same finish, the same thickness, and having been subject to the same hatdening and tempering treatment.

4.3 Sampling.

4.3.1 Product Analysis. Samples for product analysis of chemical composition shall be taken from three different coils in each lot. Each sample shall be analyzed separately.

4.3.2 Mechanical properties.

4.3.2.1 Hardness and tensile strength. Sample far hardness tests shall be taken from 2 different coils representing each 5,000 pounds (2270 kg) of steel in the lot or from 2 cut lengths representing different coils in each 5,000 pounds (2270 kg) in the lot,

4.3.2.2 Cold bending. Sampling for cold bending tests shall be as negotiated between the contractor and procuring activity.

4.3.3 Microexamination for decarburization. Samples shall be taken from I coil in each lot or from one cut length in each lot.

4.4 Examination.

4.4.1 Visual. A representative sampling of the steel shall be examined for compliancewith the requirements for finish (see 3.5), edge (see 3.6), and workmanship (see 3.98), and identification marking (see 3.8).

Downloaded from http://www.everyspec.com

4.4.2 Dimensional. A representative number of meaauremente shall, be taken on each lot to determine compliance with the size and tolerance requirements (see 3.7). Thickness measurements shall be made with a micrometer,

4.4.2.1 Camber. Camber is the deviation of a side edge from a straight line. The deviation shall be obtained by placing an eight-foot (2.44 metre) straight edge on the concave eide and measuring the maximum distance between the steel edge and the straight edge. (See table 1C of ASTM A109)

4.5 Teats,

4.5.1 Test specimens,

4.5.1.1 Chemical composition. Specimens for chemical analysis shall be prepared in accordance with ASTM A751.

4.5.1.2 Mechanical properties.

4.5.1.2.1 Hardness. Specimens shall be prepared in accordance with ASTM E 18.

4.5.1.2.2 Tensile strength. Specimens shall be prepared in accordance with ASTM E 8.

4.5.1.2.3 Cold bending. Specimens for cold bending shall be prepared as negotiated between the supplier and procuring activity.

4.5.1.3 Microexamination.

4.5.1.3.1 Decarburiastion. Two specimens shall be prepared from the sample. The prepared surface of the specimens shall be not lees than 1 inch (25.4mm) in length representing the full thickness of the etrip and shall be perpendicular to the direction of rolling.

4.5.2 Test methods.

4.5.2.1 Chemical composition. Chemical composition shall be conducted in accordance with ASTM A751.

4.5.2.2 Mechanical properties.

4.5.2.2.1 Hardness tests. Hardness tests shall be conducted in accordance with ASTM E 18.

4.5.2.2.2 Tensile strength. Tensile strengths shall be conducted in accordance with ASTM E8.

4.5.2.2.3 Cold bending. Cold bending tests shall be negotiated between the supplier and procuring activity.

Downloaded from http://www.everyspec.com

4.5.2.3 Microexamination.

4.5.2.3.1 Decarburization. Microexamination of the specimens for decarburization shall be made at a magnification of 100 diameters.

4.6 Rejection.

4.6.1 Rejection. Unless otherwise specified (see 6.2) where one or more test specimens fail to meet the requirements of the specification the lot represented by the specimen or specimens shall be subject to rejection.

4.6.2 Retest. When no sampling plan is provided or approved by the procuring agency (see 6.2) and where there is evidence that indicates that the specimen was not representative of the lot of material, and when the detail specification does not otherwise specify, at least two specimens shall be seleoted to replace each test specimen which failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection,

5. PACKAGING

5.1 Preservation. Strip shall be prepared for shipment in accordance with levels A, B, or C (defined In MIL-STD-163), as specified (see 6.1).

5.1.1 Levels A and B. Strip shall be coated with a preservative lubricating oil conforming to MIL-L-3150.

5.1.2 Level C. Strip shall be protected in accordance with general industry practice with a suitable anti-rust oil.

5.2 Packing. Strip shall be packed for shipment in accordance with level A, B, or C as specified (see 6.1).

5.2.1 Level A. Strip shall be packed in accordance with the requirements of MXL-STD-163.

5.2.2 Level c. Strip shall be packed in a manner to insure carrier acceptance and eafe delivery at destination.

5.3 Marking for shipment. In addition to marking specified in the contract or order, marking for shipment shall be in accordance with the requirements of MIL-STD-129.

6. NOTES

6.1 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) Chemical composition (see 3.2).
(c) Hardness (see 3.3.1) or tensile strength (3.3.2).
(d) If other than scaleless, tempered finish is required (see 3.5).

Downloaded from http://www.everyspec.com

(e) Size required (see 3.7).
(f) Additional identification larking, if required (see 3.8).
(g) Lot size, if other than as specified in 4.2.
(h) Level of preservation and packing required (see section 5).

6.2 Selection of chemical composition,

6.2.1 Steel grade designation numbers. While it is not common practice to specify cold rolled carbon steel strip to numerical designations indicating chemical composition, designations covering compositions (cast or heat analysis) commonly produced to this specification are shown in table II and may be used as a guide in procurement,

TABLE II. Chemical composition - heat analysis.

AISI number	UNS Number a/	Carbon, %	Manganese, %	Phosphorus, % (max.)	Sulphur, % (max.)	Silicon, %
1065	G10650	0.59-0.73	0.60-0.90	0.040	0.050	0.15-0.30
1074	C10740	.69- .80	.50- .80	.040	.050	.15- .30
1085	G10850	.80- .94	.70-1.00	.040	.050	.15- .30
1095	G10950	.91-1.04	.30-0.50	.040	.050	.15- .30

a/ Previously released engineering drawings and other documents which specify a J-digit AISI number may be converted to the above UNS numbers by inserting a prefix "G" and a suffix "0" to the AISI number.

6.2.2 Minimum and maximum limits and ranges. When cold rolled carbon spring steel in strip form is specified to chemical composition, the compositions are commonly prepared using the cast or heat ranges and limits shown in table III. Por steel manufactured by any process, the elements comprising the desired chemical composition are specified in one of three ways.

(a) By a maximum limit
(b) By a minimum limit
(c) By minimum end maximum limits, termed the range; by a summon usage, the range is the arithmetical difference between the two limits (e.g., 0.60 to 0.72 is a 0.12 range)

Downloaded from http://www.everyspec.com

TABLE III. Cold rolled carbon spring steel, cast or heat chemical ranges and limits.

Element	Standard chemical ranges and limits, percent		
	When maximum of specified element is	Range	Lowest Maximum
Carbon (see Note 1)	Over 0.60 to 0.80 incl.	0.11	0.60
	Over .80 to 1.35 incl.	.14	
Manganese	To 0.50 incl.	0.20	0.40
	Over 0.50 to 1.15 incl.	.30	
	over 1.15 to 1.65 incl.	.35	
Phosphorus	To 0.08 incl.	0.03	0.04
	Over 0.08 to 0.15 incl.	.05	.04
Sulphur	To 0.08 incl.	0.03	0.05
	Over 0.08 to C.15 fncl.	0 05	.05
	Over .15 to .23 incl.	0 07	.05
	Over .23 to .33 incl.	.10	.05
Silicon			0.10
	To 0.15 incl.	0.08	
	Over 0.15 to 0.30 incl.	.15	
	Over .30 to . 60 incl.	.30	
Copper	When copper is required 0.20 minimum is commonly specified		

Note 1. Carbon: The carbon ranges shown in the column headed "Range" apply when the specified maximum limit for manganese does not exceed 1.00 percent. When the maximum manganese limit exceeds 1.00 percent, add 0.01 to the carbon rangaes shown above.

Downloaded from http://www.everyspec.com

6.3 Finish. Cold rolled carbon spring steel in strip form, hardened and tempered is also furnished in the following finishes:

(a) Black tempered
(b) Bright tempered
(c) Tempered and polished
(d) Tempered, polished and colored blue or straw

6.4 Key Words

Cold rolled
Carbon steel.
Spring s
Coils
Killed steel
Auetenite grain size

6.5 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

6.6 SI (metric) equivalents contained in this specification are in accordance with ASTM E 380.

Custodian:
Army - MR

Review activities:
Army - AV, MI, AR
DSA - I S

User aatfvitles:

Army-AT
Navy - OS, SH

Preparing activity:
Army - MR

Project 9515-A050

(KBWP# ID-0238A/DISK 0141A. FOR MTL USE ONLY)