

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

### MILITARY SPECIFICATION

STRIP, METAL, CARBON STEEL, COLDROLLED, 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 supplement thereto, cited in the solicitation.

---

~~Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document 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.

**MIL-S-46049C**

## 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 issue 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 hardness 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 **sheet#** 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.

## MIL-S-46049C

## 3. REQUIREMENTS

3.1 Type of steel. The steel shall be produced *from* fully killed steel to which sufficient aluminum **has** been added to produce a fine austenitic 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 performed 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**.

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
>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 - 0.059 (1.02 - 1.50)	Rockwell C hardness	37.5-45.5	39.5-47.5	41.5-49.5	43.5-51.5	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	65.0-73.5
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	82.0-87.0	83.0-88.0	83.5-88.5
0.005 - 0.009 (0.127 - 0.224)	U.T.S. <sup>b/</sup> , 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)

<sup>a/</sup> 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 ksi (137.9 MPa)

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

## MIL-S-46049C

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** hardening 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** for 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 1 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 **compliance with** the requirements for finish (see 3.5), edge (see 3.6), and **workmanship** (see 3.98), and identification marking (see 3.8).

## MIL-S-46049C

4.4.2 Dimensional. A **representative** number of measurements 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 side and measuring the **maximum distance** between the steel edge and the **straight** edge. (See table 1C of ASTM A109)

4.5 Tests,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 Decarburization. Two specimens shall be prepared **from** the sample. The prepared surface of the specimens shall be **not** less than **1** inch (25.4mm) in length representing **the full** thickness of the strip 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.

## MIL-S-46049C

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 selected 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 safe 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).

## MIL-S-46049C

- (e) Size required (see 3.7).
- (f) Additional identification marking, 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 <sup>a/</sup>	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

<sup>a/</sup>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. For 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 and maximum limits, termed the range; by a common usage, the range is the arithmetical difference between the two limits (e.g., 0.60 to 0.72 is a 0.12 range)



## MIL-S-46049C

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

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

## MIL-S-46049C

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  
Austenite 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**

Preparing activity:  
**Army - MR**

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

Project **9515-A050**

User activities:

Army-AT  
**Navy - OS, SH**

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