Designation: A 684/A 684M – 06

Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled[1]

This standard is issued under the fixed designation A 684/A 684M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers cold-rolled, high-carbon strip. It is furnished in the following types as specified:

1.1.1 Soft spheroidized annealed high-carbon steel is intended for applications requiring maximum cold forming. It is normally produced to give the lowest maximum Rockwell hardness for each grade.

1.1.2 Soft annealed high-carbon steel is intended for applications requiring moderate cold forming. It is produced to a maximum Rockwell hardness.

1.1.3 Intermediate hardness high-carbon steel is intended for applications where cold forming is slight or a stiff, springy product is needed, or both. It is produced to specified Rockwell hardness ranges, the maximum being higher than obtained for the annealed type.

1.1.4 Full hard high-carbon steel is intended for flat applications. It is produced to minimum Rockwell hardness requirements, which vary with grade, microstructure and gage. Full hard can be produced with either a pearlitic or spheroidized microstructure or a mixture of both. The minimum hardness should be established between the consumer and the producer.

1.2 This specification is applicable for orders in either inch-pound units or SI units.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 682/A 682M Specification for Steel, Strip, High-Carbon, Cold-Rolled, General Requirements For

E 3 Guide for Preparation of Metallographic Specimens

3. Terminology

3.1 *Number 1 or matte (dull) finish*—finish without luster, produced by rolling on rolls roughened by mechanical or chemical means. This finish is especially suitable for lacquer or paint adhesion, and is beneficial in aiding drawing operations by reducing the contact friction between the die and the strip.

3.2 *Number 2 (regular bright) finish*—finish produced by rolling on rolls having a moderately smooth finish. It is less suitable that No. 1 (matte) finish for cold forming and may be applicable for certain types of plating.

3.3 *spheroidizing*—the heating and cooling of the strip in controlled conditions (annealing) to produce a spheroidal or globular form of carbide microconstituent.

3.4 *stretcher strains*—elongated markings that appear on the surface of the strip when dead soft (fully annealed) material is deformed beyond its yield point (see 5.2).

4. Ordering Information

4.1 Orders for material under this specification shall include the following information:

4.1.1 ASTM designation and date of issue,

4.1.2 Name, type, and steel grade number,

4.1.3 Hardness (if intermediate or restricted hardness is specified),

4.1.4 Decarburization (if required),

4.1.5 Application,

4.1.6 Dimensions,

4.1.7 Coil size requirements,

4.1.8 Edge (indicate No. 1 round, square, etc.),

4.1.9 Finish (indicate and specify),

4.1.10 Conditions (specify whether material is oiled or dry),

4.1.11 Package (bare coils, skid, etc.),

4.1.12 Cast or heat (formerly ladle) analysis report (if required), and

4.1.13 Special requirements (if required).

NOTE 1—A typical ordering description is as follows: ASTM A 684 dated ———Cold Rolled, High-Carbon Soft, Strip, Spheroidized 1064, 0.042 in. by 6 in. by coil (16 in. ID by 40 in. OD max), No. 5 Edge, No. 2 Finish, Oiled, Bare Skid or

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys, and is the direct responsibility of Subcommittee A01.19 on Steel Sheet and Strip.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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"ASTM A 684 dated ———Cold Rolled, High-Carbon, Soft, Strip, Spheroidized 1064, 0.6 mm by 200 mm by coil (400 mm ID by 7500 mm OD max), No. 3 Edge, No. 2 Finish, Oiled, Bare Skid."

5. Manufacture

5.1 *Condition*:

5.1.1 The strip shall be furnished cold rolled spheroidized annealed, soft annealed, intermediate hardness, or full hard, as specified.

5.1.2 Intermediate hardness may be obtained by either rolling the strip after final annealing or by varying the annealing treatment, or both.

5.2 *Pinch Pass*—Spheroidized annealed and annealed material may be pinch rolled after the final anneal to improve flatness, uniformly oil, modify surface, and minimize stretcher strains if required by the purchaser.

6. Chemical Requirements

6.1 *Cast or Heat Analysis*—The heat or cast analysis shall conform to that specified in Specification A 682/A 682M for the steel grade ordered; or to such other limits as may be specified using the standard ranges in Specification A 682/A 682M.

7. Metallurgical Structure

7.1 Pearlite is the normal structure of cold rolled high-carbon strip unless it has had an intermediate anneal.

7.2 Annealed is mostly a spheroidized structure, but may contain some vestiges of pearlite.

7.3 Spheroidize annealed is essentially free of pearlite.

7.4 At least one specimen shall be taken from each lot (see Specification A 682/A 682M) for microexamination.

7.4.1 The specimens shall be prepared for microscopic examination in accordance with Guide E 3.

8. Mechanical Requirements

8.1 *Hardness*:

8.1.1 *Spheroidized Annealed and Annealed Types*—When furnished spheroidized annealed or annealed, the hardness of the strip shall not exceed the maximum values specified in Fig. 1 and Fig. 2 for the applicable carbon range and type.

8.1.2 *Intermediate Hardness Type*—When furnished as intermediate hardness, the hardness of the strip shall conform to the range specified on the purchase order. The maximum hardness limit and the corresponding minimum shall be specified by the purchaser. If the maximum temper is under Rockwell B 100 (15T93 or 30T82), that scale should be used exclusively. If the minimum temper is over Rockwell C 20 (15N69.5 or 30N41.5), that scale should be used exclusively. For accuracy in testing, the hardness scales should not overlap. On either hardness scale, a range of ten points arithmetic difference is required. Refer to Table 1 for appropriate scale testing requirements.

8.1.3 Full hard is specified to a minimum hardness value. Refer to Table 1 for appropriate scale testing requirements.

8.1.4 At least one specimen shall be taken from each lot (see Specification A 682/A 682M).

8.1.5 The sample shall be tested in accordance with Test Methods and Definitions A 370.

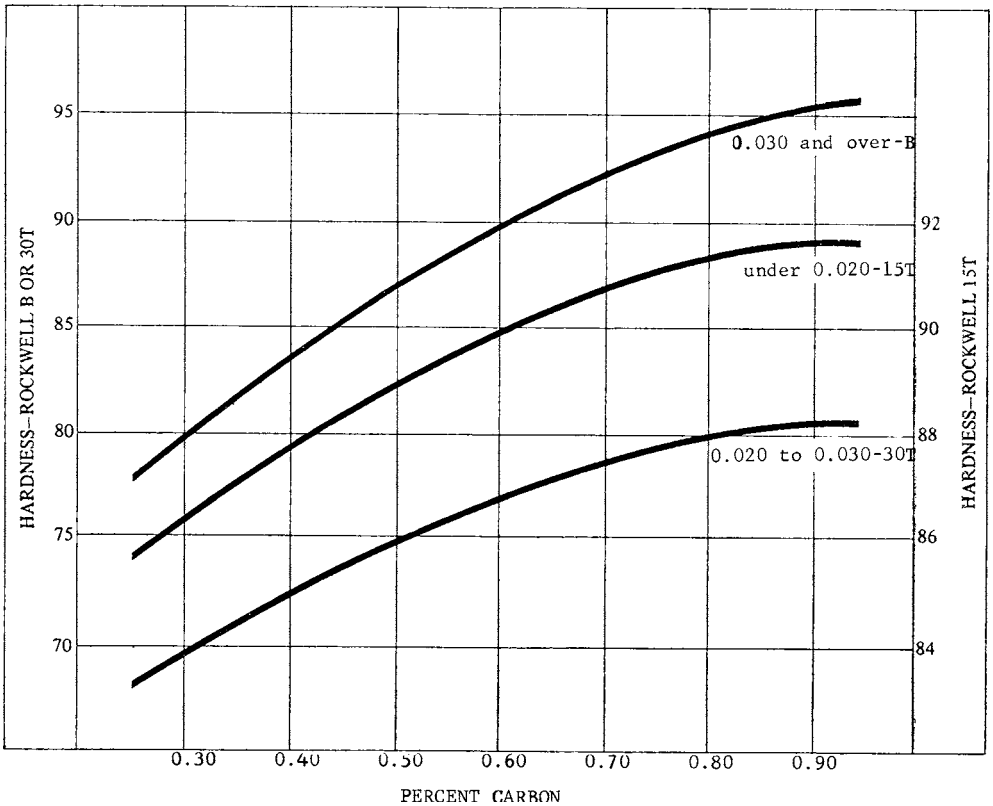

FIG. 1 Approximate Relationship Between Carbon Designations and the Maximum Hardness Limit of Soft Type Annealed Cold Rolled High Carbon Steel Strip

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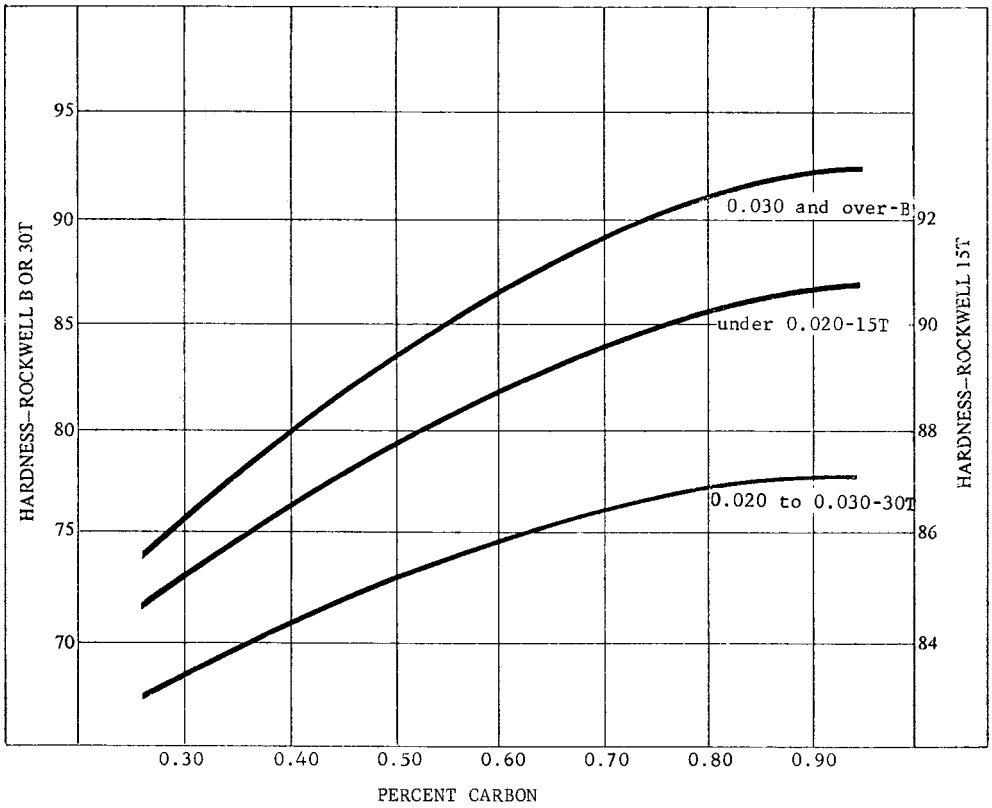

FIG. 2 Approximate Relationship Between Carbon Designations and the Maximum Hardness Limit of Spheroidized Annealed Cold Rolled High Carbon Steel Strip

TABLE 1 Rockwell Hardness Testing Ranges for Cold-Rolled High-Carbon Steel Strip

Rockwell "B" and "T" Scales		Rockwell "C" and "N" Scales	
Thickness	Scale	Thickness	Scale
Over 0.030 in. [over 0.8 mm]	B	Over 0.040 in. [over 1.0 mm]	C
0.020 to 0.030 in. [0.5 to 0.8 mm]	30T	0.025 to 0.040 in. [0.6 to 1.0 mm]	30N
Under 0.020 in. [under 0.5 mm]	15T	Under 0.025 in. [under 0.6 mm]	15N

TABLE 2 Cold Bending Requirements[A,B] for Spheroidized, Annealed, and Soft-Annealed Cold-Rolled Carbon Steel Strip

Type	Degree of Bend	Inside Radius to Thickness	Relation of Bend Test Specimen to Rolling Direction
Annealed	180°	3*t*	transverse[C]
Spheroidized	180°	2*t*	transverse[C]

[A] Up to 0.100 in. [2.5 mm], incl, thickness maximum. When bend radius for thickness is over 0.100 in. [2.5 mm] the producer should be consulted. These ratios apply to bending performance of the test specimen.

[B] These bend tests apply to the bending performance of test specimens only. Where material is to be bent in fabricating operations a more liberal bend radius may be required and should be based on prior experience or consultation with the steel producer, or both.

[C] If finished strip width prohibits taking a transverse bend test specimen, a longitudinal specimen may be substituted, except the bend radius shall be reduced by 1*t*.

8.2 *Bend Test*:

8.2.1 The steel strip produced as spheroidized, or the annealed type shall meet the cold bend requirement in Table 2. Any visible cracking on the tension side of the bend portion shall be cause for rejection.

8.2.2 At least one specimen shall be taken from each lot (see Specification A 682 or A 682M).

8.2.3 The specimen shall be the full thickness and shall be taken transverse to the rolling direction as described in Test Methods and Definitions A 370. The edges of the bend test specimens shall be rounded and free of burrs; filing or machining is permissible.

9. Finish and Edges

9.1 *Surface*—The strip shall be furnished with a No. 2 Regular Bright or No. 1 Matte (Dull) finish, as specified.

9.2 *Oiling*—The strip shall be furnished oiled or dry, as specified.

9.3 *Edges*—The strip shall be furnished with a No. 1 round or Square, No. 2 Mill, No. 3 Square Slit, No. 4 Approximately Round, No. 5 Approximately Square Burr Free, or No. 6 Approximately Square Edge, as specified.

10. General Requirements

10.1 Material furnished under this specification shall conform to the applicable requirements for the current edition of either Specification A 682/A 682M.

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