**Designation: ~~A1035/A1035M – 20~~ A1035/A1035M – 23**

# Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement[1]

This standard is issued under the fixed designation A1035/A1035M; 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.

## 1. Scope*

1.1 This specification covers deformed and plain low-carbon, chromium, steel bars, in cut lengths and coils for concrete reinforcement. These bars are furnished in three alloy types depending on the chromium range content. The standard sizes and dimensions of deformed bars and their number designations are given in Table 1.[2]

1.2 Bars are of two minimum yield strength levels as defined in 9.2: namely, 100 000 psi [690 MPa], and 120 000 psi [830 MPa] designated as Grade 100 [690] and Grade 120 [830], respectively.

1.3 Bars are furnished to three different chemical compositions, designated as Alloy Type CL, CM, and CS. Chemical compositions are shown in Table 2.

1.4 Plain bars, in sizes up to and including 2.25 in. ~~[57.2 mm]~~ [57.2 mm] 2½ ~~in.~~ in. [63.5 mm] in diameter in coils and cut lengths, when ordered shall be furnished under this specification in Grade 100 [690] and Grade 120 [830]. For ductility properties (elongation and bending), test provisions of the nearest smaller nominal diameter deformed bar size shall apply. Requirements providing for deformations and marking shall not be applicable.



NOTE 1—Welding of the material in this specification should be approached with caution since no specific provisions have been included to enhance its weldability. When this steel is to be welded, a welding procedure suitable for the chemical composition and intended use or service should be used.

NOTE 2—Designers need to be aware that design codes and specifications may not recognize the use of the No. 20 [64] bar, the largest bar size included in this specification. Structural members reinforced with No. 20 [64] bars may require approval of the building official or other appropriate authority and require special detailing to ensure adequate performance at service and factored loads.

1.5 Requirements for alternate bar sizes are presented in Annex A1. The requirements in Annex A1 only apply when specified by the purchaser (see 4.2.4).

1.6 A supplementary requirement (S1) is provided for use where bend testing of bar designation Nos. 14 and 18 [43, 57], and bar designation Nos. 40, 50, and 60 in Annex A1, is required by the purchaser. The supplementary requirement applies only when specified in the purchase order.

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[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 A01.05 on Steel Reinforcement.

Current edition approved ~~June 1, 2020~~March 1, 2023. Published ~~June 2020~~April 2023. Originally approved in 2004. Last previous edition approved in ~~2019~~2020 as ~~A1035/A1035M – 19.~~A1035/A1035M – 20. DOI: ~~10.1520/A1035_A1035M-20.~~10.1520/A1035_A1035M-23.

[2] Commercial Metals Company has several patented materials (US Patents #6,273,968, #6,709,534, #7,118,637, #7,214,278) that meet this specification. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

***A Summary of Changes section appears at the end of this standard**

**TABLE 1 Deformed Bar Designation Numbers, Nominal Weights [Masses], Nominal Dimensions, and Deformation Requirements**

| Bar Designation No. | Nominal Weight, lb/ft [Nominal Mass, kg/m] | Nominal Dimensions[A] | | | Deformation Requirements, in. [mm] | | |
|---|---|---|---|---|---|---|---|
| | | Diameter, in. [mm] | Cross-Sectional Area, $in.^2$ [$mm^2$] | Perimeter in. [mm] | Maximum Average Spacing | Minimum Average Height | Maximum Gap (Chord of 12.5 % of Nominal Perimeter) |
| 3 [10] | 0.376 [ 0.560] | 0.375 [ 9.5] | 0.11 [ 71] | 1.178 [ 29.9] | 0.262 [ 6.7] | 0.015 [0.38] | 0.143 [ 3.6] |
| 4 [13] | 0.668 [ 0.994] | 0.500 [12.7] | 0.20 [ 129] | 1.571 [ 39.9] | 0.350 [ 8.9] | 0.020 [0.51] | 0.191 [ 4.9] |
| 5 [16] | 1.043 [ 1.552] | 0.625 [15.9] | 0.31 [ 199] | 1.963 [ 49.9] | 0.437 [11.1] | 0.028 [0.71] | 0.239 [ 6.1] |
| 6 [19] | 1.502 [ 2.235] | 0.750 [19.1] | 0.44 [ 284] | 2.356 [ 59.8] | 0.525 [13.3] | 0.038 [0.97] | 0.286 [ 7.3] |
| 7 [22] | 2.044 [ 3.042] | 0.875 [22.2] | 0.60 [ 387] | 2.749 [ 69.8] | 0.612 [15.5] | 0.044 [1.12] | 0.334 [ 8.5] |
| 8 [25] | 2.670 [ 3.973] | 1.000 [25.4] | 0.79 [ 510] | 3.142 [ 79.8] | 0.700 [17.8] | 0.050 [1.27] | 0.383 [ 9.7] |
| 9 [29] | 3.400 [ 5.060] | 1.128 [28.7] | 1.00 [ 645] | 3.544 [ 90.0] | 0.790 [20.1] | 0.056 [1.42] | 0.431 [10.9] |
| 10 [32] | 4.303 [ 6.404] | 1.270 [32.3] | 1.27 [ 819] | 3.990 [101.3] | 0.889 [22.6] | 0.064 [1.63] | 0.487 [12.4] |
| 11 [36] | 5.313 [ 7.907] | 1.410 [35.8] | 1.56 [1006] | 4.430 [112.5] | 0.987 [25.1] | 0.071 [1.80] | 0.540 [13.7] |
| 14 [43] | 7.65 [11.38 ] | 1.693 [43.0] | 2.25 [1452] | 5.32 [135.1] | 1.185 [30.1] | 0.085 [2.16] | 0.648 [16.5] |
| 18 [57] | 13.60 [20.24 ] | 2.257 [57.3] | 4.00 [2581] | 7.09 [180.1] | 1.58 [40.1] | 0.102 [2.59] | 0.864 [21.9] |
| 20 [64][B] | 16.69 [24.84 ] | 2.500 [63.5] | 4.91 [3167] | 7.85 [199.5] | 1.75 [44.5] | 0.113 [2.86] | 0.957 [24.3] |

[A] The nominal dimensions of a deformed bar are equivalent to those of a plain round bar having the same weight [mass] per foot [metre] as the deformed bar.
[B] Refer to Note 2.

**TABLE 2 Chemical Compositions of Alloy Type**

| Alloy Type | Composition Max, %[A] | | | | | | |
|---|---|---|---|---|---|---|---|
| | Carbon | Chromium | Manganese | Nitrogen | Phosphorus | ~~Sulfer~~Sulfur | Silicon |
| 1035 CL | 0.3 | 2.0–3.9 | 1.5 | 0.05 | 0.035 | 0.045 | 0.5 |
| ~~1035 CM~~ | ~~0.2~~ | ~~4.0–7.9~~ | ~~1.5~~ | ~~0.05~~ | ~~0.035~~ | ~~0.045~~ | ~~0.5~~ |
| 1035 CM | 0.2 | 4.0–10.9 | 1.5 | 0.05 | 0.035 | 0.045 | 0.5 |
| 1035 CS | 0.15 | 8.0–10.9 | 1.5 | 0.05 | 0.035 | 0.045 | 0.5 |

[A] Maximum unless range is indicated; percentages refer to weight [mass] percentages.



1.7 The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.8 This specification is applicable for orders in either inch-pound units (as Specification A1035) or in SI units (as Specification A1035M).



1.9 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. 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 specification.

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[3]

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
A370 Test Methods and Definitions for Mechanical Testing of Steel Products
A510/A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
A751 Test Methods and Practices for Chemical Analysis of Steel Products
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E290 Test Methods for Bend Testing of Material for Ductility

2.2 *U.S. Military Standard:*[4]

MIL-STD-129 Marking for Shipment and Storage

2.3 *U.S. Federal Standard:*[4]

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

## 3. Terminology

3.1 *Definitions of Terms Specific to This Specification:*

3.1.1 *deformations, n*—transverse protrusions on a deformed bar.

3.1.2 *deformed bar, n*—steel bar with protrusions; a bar that is intended for use as reinforcement in reinforced concrete construction.

3.1.2.1 *Discussion*—

The surface of the bar is provided with protrusions that inhibit longitudinal movement of the bar relative to the concrete surrounding the bar in such construction. The protrusions conform to the provisions of this specification.

3.1.3 *lot, n*—all the bars of one bar size and pattern of deformations contained in an individual shipping release or shipping order.

3.1.4 *plain bar, n*—steel bar without protrusions.

3.1.5 *rib, n*—longitudinal protrusion on a deformed bar.

## 4. Ordering Information

4.1 Orders for low-carbon, chromium steel bars for concrete reinforcement under this specification shall contain the following information:

4.1.1 Quantity (weight) [mass];

4.1.2 Deformed or plain;

4.1.3 Bar designation number (size) of deformed bars, or nominal diameter (size) of plain bars;

4.1.4 Cut lengths or coils;

4.1.5 Alloy Type (see Table 2);

4.1.6 Grade; and

4.1.7 ASTM designation A1035 [A1035M] and year of issue.

4.2 The purchaser shall have the option to specify additional requirements, including, but not limited to, the following:



[3] 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.

[4] Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

4.2.1 Special package marking requirements (20.2);

4.2.2 Requirements for inspection (17.1),

4.2.3 Supplementary Requirement S1, bend tests for bar designation Nos. 14 and 18 [43 and 57], or bar designation Nos. 40, 50, and 60 in Annex A1;

4.2.4 Requirements for alternate bar sizes in Annex A1; and

4.2.5 Other special requirements, if any.

## 5. Materials and Manufacture

5.1 The bars shall be rolled from properly identified heats of mold-cast or strand-cast steel. The steel shall be made by any commercially accepted process.

## 6. Chemical Composition

6.1 The chemical analysis of each heat shall be determined in accordance with Test Methods, Practice, and Terminology A751. The manufacturer shall make the analysis on test samples taken preferably during the pouring of the heat. The percentages of carbon, manganese, phosphorus, sulfur, silicon, chromium, and nitrogen, shall be determined and reported as required in Section 16.



6.2 The chemical composition for the different Alloy Types as shown by heat analysis shall be limited to Table 2 of this specification.

## 7. Requirements for Deformations

7.1 Deformations shall be spaced along the bar at substantially uniform distances. The deformations on opposite sides of the bar shall be similar in size, shape, and pattern.



7.2 The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45°. Where the line of deformations forms an included angle with the axis of the bar from 45 to 70° inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformations is over 70°, a reversal in direction shall not be required.

7.3 The average spacing or distance between deformations on each side of the bar shall not exceed seven tenths of the nominal diameter of the bar.

7.4 The overall length of deformations shall be such that the gap (measured as a chord) between the ends of the deformations on opposite sides of the bar shall not exceed 12½ % of the nominal perimeter of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25 % of the nominal perimeter of the bar; furthermore, the summation of gaps shall not exceed 25 % of the nominal perimeter of the bar. The nominal perimeter of the bar shall be 3.1416 times the nominal diameter.

7.5 The spacing, height, and gap of deformations shall conform to the requirements prescribed in Table 1.

## 8. Measurements of Deformations

8.1 The average spacing of deformations shall be determined by measuring the length of a minimum of 10 spaces and dividing that length by the number of spaces included in the measurement. The measurement shall begin from a point on a deformation at the beginning of the first space to a corresponding point on a deformation after the last included space. Spacing measurements shall not be made over a bar area containing bar marking symbols involving letters or numbers.

8.2 The average height of deformations shall be determined from measurements made on not less than two typical deformations. Determinations shall be based on three measurements per deformation, one at the center of the overall length and the other two at the quarter points of the overall length.

8.3 Insufficient height, insufficient circumferential coverage, or excessive spacing of deformations shall not constitute cause for rejection unless it has been clearly established by determinations on each lot tested that typical deformation height, gap, or spacing do not conform to the minimum requirements prescribed in Section 7. No rejection shall be made on the basis of measurements if fewer than ten adjacent deformations on each side of the bar are measured.

## 9. Tensile Requirements

9.1 The material, as represented by the test specimens, shall conform to the requirements for tensile properties prescribed in Table 3.

9.2 The yield strength shall be determined by the offset method (0.2 % offset), described in Test Methods and Definitions A370.

9.3 When material is furnished in coils, the test specimen shall be taken from the coil and straightened prior to placing it in the jaws of the tensile testing machine. (See Note 3.)

NOTE 3—Straighten the test specimen to avoid formation of local sharp bends and to minimize cold work. Insufficient straightening prior to attaching the extensometer can result in lower-than-actual yield strength readings.

9.3.1 Test specimens taken from post-fabricated material shall not be used to determine conformance to this specification. (See Note 4.)

NOTE 4—Multiple bending distortion from mechanical straightening and fabricating machines can lead to excessive cold work, resulting in higher yield strengths, lower elongation values, and a loss of deformation height.

9.4 The percentage of elongation shall be as prescribed in Table 3.

## 10. Bending Requirements

10.1 The bend test specimen shall withstand being bent around a pin without cracking on the outside radius of the bent portion. The requirements for degree of bending and sizes of pins are prescribed in Table 4. When material is furnished in coils, the test specimen shall be straightened prior to placement in the bend tester.

10.2 The bend test shall be made on specimens of sufficient length to ensure free bending and with apparatus that provides:

10.2.1 Continuous and uniform application of force throughout the duration of the bending operation.

10.2.2 Unrestricted movement of the specimen at points of contact with the apparatus and bending around a pin free to rotate.

10.2.3 Close wrapping of the specimen around the pin during the bending operation.

**TABLE 3 Tensile Properties Requirements**

| Type | A1035 CL | | A1035 CM | | A1035 CS | |
|---|---|---|---|---|---|---|
| Grade | Grade 100 [690] | Grade 120 [830] | Grade 100 [690] | Grade 120 [830] | Grade 100 [690] | Grade 120 [830] |
| Tensile strength, min, psi [MPa] | 150 000 [1030] | 150 000 [1030] | 150 000 [1030] | 150 000 [1030] | 150 000 [1030] | 150 000 [1030] |
| Yield strength (0.2 % offset), min, psi [MPa] | 100 000 [690] | 120 000 [830] | 100 000 [690] | 120 000 [830] | 100 000 [690] | 120 000 [830] |
| Elongation in 8 in. [200 mm], min, %: | | | | | | |
| Bar Designation No. | | | | | | |
| 3 through 11 [10 through 36] | 7 | 7 | 7 | 7 | 7 | 7 |
| 14, 18, 20 [43, 57, 64] | 6 | 6 | 6 | 6 | 6 | 6 |

**TABLE 4 Bend Test Requirements**

| Bar Designation No. | Pin Diameter for Bend Tests[A] |
|---|---|
| 3, 4, 5 [10, 13, 16] | 3½*d*[B] |
| 6, 7, 8 [19, 22, 25] | 5*d* |
| 9,10,11 [29, 32, 36] | 7*d* |
| 14, 18, 20 [43, 57, 64] (90°) | [C] |

[A] Test bends 180° unless otherwise agreed.
[B] *d* = nominal diameter of specimen.
[C] See Supplementary Requirement S1 for bend tests of bar designation Nos. 14, 18, 20 [43, 57, 64].

10.3 It shall be permissible to use other methods of bend testing, as described in Test Methods E290, such as placing a specimen across two round bearings free to rotate and applying the bending force with a fixed rounded-tip mandrel conforming to the specified bend radius, allowing the bar to pass through with sufficient clearance. When failures occur under other methods of bend testing, retests shall be permitted under the bend test method prescribed in 10.2.

## 11. Permissible Variation in Weight [Mass]

11.1 Deformed reinforcing bars shall be evaluated on the basis of nominal weight [mass]. The weight [mass] determined using the measured weight [mass] of the test specimen and rounding in accordance with Practice E29, shall be at least 94 % of the applicable weight [mass] per unit length prescribed in Table 1. In no case shall overweight [excess mass] of any deformed bar be the cause for rejection. Weight [mass] variation for plain bars shall be computed on the basis of permissible variation in diameter. For plain bars smaller than ⅜ ~~in.~~ in. [9.5 mm], use Specification A510/A510M. For larger plain bars up to and including 2½ ~~in.~~ in. [63.5 mm], use Specification A6/A6M.

## 12. Finish

12.1 The bars shall be free of detrimental surface imperfections.

12.2 Rust, seams, surface irregularities, or mill scale oxidation shall not be cause for rejection, provided the weight [mass], nominal dimensions, cross-sectional area, and tensile properties of a test specimen are not less than the requirements of this specification.

12.3 Surface imperfections or flaws other than those specified in 12.2 shall be considered detrimental when specimens containing such imperfections fail to conform to either tensile or bending requirements. Examples include, but are not limited to, laps, seams, scabs, slivers, cooling or casting cracks, and mill or guide marks.

NOTE 5—Deformed reinforcing bars intended for epoxy coating applications should have surfaces with a minimum of sharp edges to achieve proper coverage. Particular attention should be given to bar marks and deformations where coating difficulties are prone to occur.

NOTE 6—Deformed bars intended to be mechanically spliced or butt-spliced by welding may require a certain degree of roundness in order for the splices to adequately achieve strength requirements.

## 13. Number of Tests

13.1 One tension test and one bend test shall be made of each bar size rolled from each heat.

13.2 One set of dimensional property tests including bar weight [mass] and spacing, height, and gap of deformations shall be made of each bar size rolled from each heat.

## 14. Retests

14.1 If the results of an original tension test specimen fail to meet the specified minimum requirements and are within ~~2000 psi~~ 2000 psi [14 MPa] of the required tensile strength, within ~~1000 psi [7 MPa]~~ 1000 psi [7 MPa] of the required yield strength, or within two percentage units of the required elongation, a retest shall be permitted on two random specimens for each original tension test specimen failure from the lot. Both retest specimens shall meet the requirements of this specification.

14.2 If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in 14.4.2 and 14.4.3, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification. The retest shall be performed on test specimens that are at air temperature but not less than ~~60°F [16°C].~~60 °F [16 °C].

14.3 If a weight [mass] test fails for reasons other than flaws in the specimen as described in 14.4.3, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification.

14.4 If the original test or any of the random retests fails because of any reasons listed in 14.4.1, 14.4.2, or 14.4.3, the test shall be considered an invalid test:

14.4.1 The elongation property of any tension test specimen is less than that specified, and any part of the fracture is outside the middle half of the gage length, as indicated by scribe marks on the specimen before testing;

NOTE 7—Marking specimens with multiple scribe or punch marks can reduce the occurrence of fracture outside or near these marks and the need for declaring the test invalid.

14.4.2 Mechanical reasons such as failure of testing equipment or improper specimen preparation; and

14.4.3 Flaws are detected in a test specimen, either before or during the performance of the test.

14.5 The original results from 14.4.1, 14.4.2, or 14.4.3 shall be discarded and the test shall be repeated on a new specimen from the same lot.



## 15. Test Specimens

15.1 All mechanical tests shall be conducted in accordance with Test Methods and Definitions A370. In case of any conflict between the requirements in this specification and the requirements of Test Methods and Definitions A370, the requirements in this specification shall prevail

15.2 Tension test specimens shall be the full section of the bar as rolled. Unit stress determinations for yield and tensile strength shall be based on the nominal bar area.

15.2.1 Tension test specimens shall be long enough to provide for an 8-in. ~~[200-mm]~~[200 mm] gage length, a distance of at least two bar diameters between each gage mark and the grips.

NOTE 8—It is recommended that sufficient additional length of the test specimen be provided to fill the grips completely, leaving some excess length protruding beyond each grip. The grips should be shimmed so that no more than ½ ~~in.~~ in. [13 mm] of a grip protrudes from the head of the tensile testing machine.

15.2.2 *Gage Marks*—The 8-in. ~~[200-mm]~~[200 mm] gage length shall be marked on the specimen using a preset 8-in. ~~[200-mm]~~[200 mm] punch or, alternately, may be punch marked every 2 in. ~~[50 mm]~~ [50 mm] along the 8-in. ~~[200-mm]~~[200 mm] gage length, on one of the longitudinal ribs, if present, or in the clear spaces between transverse deformations. Punch marks shall not be placed on a transverse deformation.

NOTE 9—Light punch marks are desirable because deep marks severely indent the bar and may affect the results.

15.3 Bend test specimens shall be the full section of the bar as rolled.

## 16. Test Reports

16.1 The following information shall be reported on a per heat basis. Report additional items as requested or desired.

16.1.1 Chemical analysis including the percentages of carbon, chromium, manganese, nitrogen, phosphorus, silicon, and sulfur.