**Designation: A581/A581M – 22a**

# Standard Specification for Free-Machining Stainless Steel Wire and Wire Rods[1]

This standard is issued under the fixed designation A581/A581M; 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 U.S. Department of Defense.*

## 1. Scope*

1.1 This specification covers free-machining stainless steels of cold-finished wire and hot-finished wire rods in coils. Wire rods are a semi-finished product primarily for the manufacture of wire. Wire includes rounds, squares, hexagons, and special shapes in free-machining stainless steels designed especially for optimum machinability and for general corrosion and high-temperature service.

1.2 The following alloys are covered:

1.2.1 Austenitic alloys: UNS numbers S20300, S30300, S30310, S30323, and S30345;

1.2.2 Martensitic alloys: UNS numbers S41600, S41610, and S41623; and

1.2.3 Ferritic alloys: UNS numbers S18200, S18235, S41603, S43020, and S43023.

NOTE 1—For wire other than for free-machining applications, see Specification A580/A580M.

NOTE 2—For Free-Machining Stainless Steel Bars, see Specification A582/A582M.

1.3 The values stated in either inch-pound units or SI (metric) units are to be regarded separately as standard; within the text and tables, the SI units are shown in [brackets]. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.4 Unless the order specifies the applicable "M" specification designation, the material shall be furnished to the inch-pound units.

1.5 *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:*[2,3]

A555/A555M Specification for General Requirements for Stainless Steel Wire and Wire Rods

A580/A580M Specification for Stainless Steel Wire

A582/A582M Specification for Free-Machining Stainless Steel Bars

A751 Test Methods and Practices for Chemical Analysis of Steel Products

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 *SAE Standard:*[4]

J 1086 Practice for Numbering Metals and Alloys (UNS)

## 3. Terminology

3.1 Refer to Terminology A941 for terms related to steel, stainless steel, and related alloys.

## 4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:

4.1.1 Quantity (weight),

4.1.2 Alloy UNS Designation (see Table 1),

4.1.3 Condition (see Section 7 and Table 2),

4.1.4 Finish (see Section 9),

4.1.5 Applicable dimensions and tolerances, if different than Specification A555/A555M, including size, thickness, width, and length or coil diameter (inside or outside diameter), and coil weights,

4.1.6 Cross section (round, square, etc.),

[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 A01.17 on Flat-Rolled and Wrought Stainless Steel.

Current edition approved Nov. 1, 2022. Published November 2022. Originally approved in 1967. Last previous edition approved in 2022 as A581/A581M – 22. DOI: 10.1520/A0581_A0581M-22A.

[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.

[3] Refer to Table X1.1 for guidance regarding type designations.

[4] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

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

**TABLE 1 Chemical Requirements**

| UNS Designation[A] | Type[C] | Composition, % | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Carbon, max | Manganese[B] | Phosphorus, max | Sulfur[B] | Silicon, max | Chromium | Nickel | Other Elements |
| | | | | | AUSTENITIC ALLOYS | | | | |
| S20300 | XM-1 | 0.08 | 5.0–6.5 | 0.04 | 0.18–0.35 | 1.00 | 16.0–18.0 | 5.0–6.5 | Cu 1.75–2.25 |
| S30300 | 303 | 0.15 | 2.00 | 0.20 | 0.15 min | 1.00 | 17.0–19.0 | 8.0–10.0 | . . . |
| S30310 | XM-5 | 0.15 | 2.5–4.5 | 0.20 | 0.25 min | 1.00 | 17.0–19.0 | 7.0–10.0 | . . . |
| S30323 | 303 Se | 0.15 | 2.00 | 0.20 | 0.06 | 1.00 | 17.0–19.0 | 8.0–10.0 | Se 0.15 min |
| S30345 | XM-2 | 0.15 | 2.00 | 0.05 | 0.11–0.16 | 1.00 | 17.0–19.0 | 8.0–10.0 | Mo 0.40–0.60<br>Al 0.60–1.00 |
| S31621 | . . . | 0.03 | 2.00 | 0.04 | 0.10–0.20 | 1.00 | 16.5–18.5 | 10.0–13.0 | Cu 1.30–1.60<br>Mo 2.00–2.50<br>N 0.10 max |
| | | | | | MARTENSITIC ALLOYS | | | | |
| S41600 | 416 | 0.15 | 1.25 | 0.06 | 0.15 min | 1.00 | 12.0–14.0 | . . . | . . . |
| S41610 | XM-6 | 0.15 | 1.50–2.50 | 0.06 | 0.15 min | 1.00 | 12.0–14.0 | . . . | . . . |
| S41623 | 416 Se | 0.15 | 1.25 | 0.06 | 0.06 | 1.00 | 12.0–14.0 | . . . | Se 0.15 min |
| | | | | | FERRITIC ALLOYS | | | | |
| S18200 | XM-34 | 0.08 | 2.50 | 0.04 | 0.15 min | 1.00 | 17.5–19.5 | . . . | Mo 1.50–2.50 |
| S18235 | . . . | 0.025 | 0.50 | 0.030 | 0.15–0.35 | 1.00 | 17.5–18.5 | 1.00 | Mo 2.00–2.50<br>Ti 0.30–1.00<br>N 0.025 max<br>C+N 0.035 max |
| S41603 | . . . | 0.08 | 1.25 | 0.06 | 0.15 min | 1.00 | 12.0-14.0 | . . . | . . . |
| S43020 | 430 F | 0.12 | 1.25 | 0.06 | 0.15 min | 1.00 | 16.0–18.0 | . . . | . . . |
| S43023 | 430 F Se | 0.12 | 1.25 | 0.06 | 0.06 | 1.00 | 16.0–18.0 | . . . | Se 0.15 min |

[A] UNS designation established in accordance with Practice E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).
[B] Maximum unless otherwise noted.
[C] Refer to Table X1.1 for guidance regarding type designations.



**TABLE 2 Condition**

| UNS Designation | Type[A] | Condition A (Annealed) | Condition B (Cold Worked) | Condition T (Intermediate Temper) | Condition H (Hard Temper) |
|---|---|---|---|---|---|
| | | | AUSTENITIC ALLOYS | | |
| S20300 | XM-1 | A | B | . . . | . . . |
| S30300 | 303 | A | B | . . . | . . . |
| S30310 | XM-5 | A | B | . . . | . . . |
| S30323 | 303 Se | A | B | . . . | . . . |
| S30345 | XM-2 | A | B | . . . | . . . |
| S31621 | . . . | A | B | . . . | . . . |
| | | | MARTENSITIC ALLOYS | | |
| S41600 | 416 | A | . . . | T | H |
| S41610 | XM-6 | A | . . . | T | H |
| S41623 | 416 Se | A | . . . | T | H |
| | | | FERRITIC ALLOYS | | |
| S18200 | XM-34 | A | . . . | . . . | . . . |
| S18235 | . . . | A | B | . . . | . . . |
| S41603 | . . . | A | . . . | . . . | . . . |
| S43020 | 430 F | A | . . . | . . . | . . . |
| S43023 | 430 F Se | A | . . . | . . . | . . . |

[A] Refer to Table X1.1 for guidance regarding type designations.



4.1.7 ASTM designation (Specification A581/A581M) and date of publication, and

4.1.8 Additional requirements agreed to between the supplier and purchaser.

NOTE 3—An example of ordering description is as follows: 5000 lb [2000 kg] stainless steel wire ¼ in. [6.5 mm], Alloy UNS No. designation, Condition B (cold worked), round, coils, ASTM Specification A581/A581M-XX. End use: machined valve parts.

## 5. General Requirements

5.1 In addition to the requirements of this specification, all requirements of the current edition of Specification A555/A555M shall apply. Failure to comply with the general requirements of Specification A555/A555M constitutes nonconformance with this specification.

## 6. Chemical Composition

6.1 The material shall conform to the requirements as to chemical composition requirements specified in Table 1.

6.2 Methods and practices relating to chemical analysis required by this specification shall be in accordance with Test Methods and Practices A751.

## 7. Condition

7.1 Cold-finished wire may be furnished in one of the conditions listed in Table 2.

7.2 Wire rods may be furnished in the as-hot-rolled or as-hot-rolled and annealed condition.

## 8. Mechanical Property Requirements

8.1 Wire products shall conform to the mechanical test requirements specified in Table 3.

8.2 Wire rods shall conform to the annealed mechanical test requirements specified in Table 3.

## 9. Finish

9.1 Wire rods are furnished with a hot rolled or a hot rolled and cleaned finish.

**TABLE 3 Mechanical Test Requirements**

| UNS Designation | Type[B] | Condition (see Section 7) | Tensile Strength | |
|---|---|---|---|---|
| | | | ksi | [MPa] |
| All except S18235 | . . . | A | 85 to 125 | [585 to 860] |
| S18235 | . . . | A | 60 to 90 | [415 to 620] |
| | | B[A] | 80 to 120 | [550 to 830] |
| S20300 | XM-1 | B[A] | 115 to 145 | [795 to 1000] |
| S30300 | 303 | | | |
| S30310 | XM-5 | | | |
| S30323 | 303Se | | | |
| S30345 | XM-2 | | | |
| S31621 | . . . | A | 73 to 101 | [500 to 700] |
| | | B[A] | 140 to 175 | [965 to 1210] |
| S41600 | 416 | T | 115 to 145 | [790 to 1000] |
| S41610 | XM-6 | | | |
| S41623 | 416Se | | | |
| S41600 | 416 | H | 140 to 175 | [965 to 1210] |
| S41610 | XM-6 | | | |
| S41623 | 416Se | | | |

[A] Condition B applies only to wire annealed and cold worked to produce high strength in chromium-nickel alloys not hardenable by heat treatment.
[B] Refer to Table X1.1 for guidance regarding type designations.

9.2 Wire in the cold-finished condition, is generally furnished with a cold-drawn finish.

## 10. Keywords

10.1 free-machining; free-machining wire; stainless steel



## APPENDIX

**(Nonmandatory Information)**

## X1. CROSS REFERENCE



X1.1 This table is intended to assist the user when Specification A581/A581M is referenced in a government procurement. It shows the types of steels in Specification A581/A581M replacing the steels formerly specified in MIL-W-52263C(MR).

**TABLE X1.1 Cross Reference**

| UNS Designation[A] | MIL-W-52263C(MR) | Specification A581, Type |
|---|---|---|
| S20300 | 203 EZ | XM-1 |
| S30300 | 303 | 303 |
| S30310 | 303 plus X | XM-5 |
| S30323 | 303 Se | 303 Se |
| S30345 | 303 Ma | XM-2 |
| S41600 | 416 | 416 |
| S41610 | 416 plus X | XM-16 |
| S41623 | 416 Se | 416 Se |
| S43020 | 430 F | 430 F |
| S43023 | 430 Se | 430 F Se |

[A] UNS designation established in accordance with Practice E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).