

ASTM A479 / A479M — Stainless Steel Bars & Shapes for Boilers & Pressure Vessels

Your condensed guide to the standard governing stainless steel rounds, squares, hexagons and hot-rolled/extruded shapes destined for boiler and pressure-vessel construction — grades, chemistry, mechanical properties, and everything you need before ordering.

Standard Designation: **A479/A479M**

Edition: **06a**

ASME Code Equivalent: **SA-479/SA-479M**

Companion General Spec: **A484/A484M**

01

Scope & Application

What A479 covers — and how it differs from general-purpose bar specifications.



Products Covered

Hot- and cold-finished stainless steel bars — **rounds, squares, hexagons** — plus **hot-rolled or extruded shapes** such as angles, tees and channels.



Premium Application Class

Exclusively for **boiler and pressure-vessel construction**. The ASME Boiler & Pressure Vessel Code counterpart is **SA-479/SA-479M** (Section II).



Built on A484/A484M

All general requirements — ordering info, dimensions, tolerances, workmanship, packaging, certification — come from **Specification A484/A484M**. Non-compliance with A484 = non-conformance with A479.



Four Metallurgical Families

Covers **austenitic, austenitic-ferritic (duplex), ferritic** and **martensitic** stainless steels — ~75 UNS designations in total.



High-Temperature Special Grades

Includes **H grades** (304H, 316H, 321H, 347H, 309H, 310H, 348H) with controlled carbon and grain size for elevated-temperature creep resistance.



Dual Unit System

Inch-pound and SI [metric] values are treated as separate standards. Unless the order cites the "**M**" **designation**, material is furnished to inch-pound units.



A479 vs A276 — which one do you need?

Both cover stainless bars, but **A479 is the pressure-vessel specification**: it adds grain-size control for H grades, intergranular-corrosion capability, and supplementary requirements for high-temperature ASME service. For non-code general applications, ASTM A276 is typically specified; when the part goes into a boiler or coded pressure vessel, specify A479.

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Grade Overview

~75 UNS designations in four metallurgical families. Below are the most specified grades, grouped by family with quick-selection tags.

Austenitic Grades

LARGEST FAMILY • ~50 DESIGNATIONS

Most Specified

304 / 304L / 304H

S30400 • S30403 • S30409

The workhorse 18-8 grades. L for welding, H for >1000 °F service.

ALL-PURPOSE

Most Specified

316 / 316L / 316H

S31600 • S31603 • S31609

2–3% Mo added for pitting resistance. 316L is the default corrosion choice.

CORROSION

321 / 347 / 348

S32100 • S34700 • S34800

Titanium (321) or columbium/niobium (347/348) stabilized against sensitization.

STABILIZED

WELD SERVICE

309S/H • 310S/H

S30908 • S30909 • S31008 • S31009

High Cr-Ni heat-resistant grades for furnace and boiler service.

HIGH TEMP

304N / 316N

S30451 • S31651

Nitrogen-strengthened — higher strength than base grades.

HIGH STRENGTH

Nitronic® Family

XM-19 • XM-17/18 • XM-11 • XM-29

High-strength Mn-N austenitics: S20910, S21600/03, S21904, S24000.

HIGH STRENGTH

6-Mo Super Austenitics

N08367 • S31254 • S32654

6–8% Mo for severe chloride service. S32654 tops 109 ksi yield... check table.

SEVERE CORROSION

317 Family

S31700 • S31725 • S31726 • S31727

3–5% Mo upgrades over 316; S31726/27 add N and Cu.

CHEMICAL SERVICE

Austenitic-Ferritic (Duplex) Grades

11 DESIGNATIONS • 2× YIELD STRENGTH

Most Specified

2205

S31803 / S32205

The standard 22Cr duplex — 65 ksi min yield, strong SCC resistance.

STANDARD DUPLEX

2507

S32750

25Cr super duplex, 116 ksi tensile (≤ 2 in.), PREN > 40.

SUPER DUPLEX

2101 Lean Duplex

S32101

Low-Ni economical duplex for structural pressure parts.

ECONOMICAL

Other Duplexes

S32506 • S32550 • S32760 • S32906 • S32950 • S39277

Super duplex and specialty grades with Cu/W additions.

SPECIALTY

Ferritic Grades

7 DESIGNATIONS

430 / 439

S43000 • S43035

General 17–18% Cr ferritics; 439 is Ti-stabilized.

444

S44400

18Cr-2Mo — chloride SCC-immune, good heat-exchanger bar stock.

XM-27 • S44700 • S44800

S44627 • S44700 • S44800

Super ferritics with 26–30% Cr — extreme chloride resistance.

405

S40500

12Cr with Al addition — weldable, resists air hardening.

Martensitic Grades

7 DESIGNATIONS • HEAT-TREATABLE

410 / 403

S41000 • S40300

12% Cr hardenable grades. 403 limits Cr to 13% for turbine-blade quality.

414

S41400

12Cr-2Ni — higher hardenability, tempered to 115 ksi.

431

S43100

16Cr-2Ni — the highest-strength corrosion-resistant martensitic.

S41500 • S41425 • XM-30

S41500 • S41425 • S41040

F6NM-type and enhanced 12Cr grades for hydro/nuclear service.

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Chemical Composition

Composition is reported to the purchaser and must conform to Table 1 of the standard. Below: the most-ordered grades. Values are % max unless a range is shown.

UNS	Type	C	Mn	P	S	Si	Cr	Ni	Mo
Austenitic — Core Grades									
S30400	304	0.08 ^C	2.00	0.045	0.030	1.00	18.0–20.0	8.0–10.5	—
S30403	304L	0.030	2.00	0.045	0.030	1.00	18.0–20.0	8.0–12.0	—
S30409	304H	0.04–0.10	2.00	0.045	0.030	1.00	18.0–20.0	8.0–10.5	—
S31600	316	0.08 ^C	2.00	0.045	0.030	1.00	16.0–18.0	10.0–14.0	2.00–3.00
S31603	316L	0.030	2.00	0.045	0.030	1.00	16.0–18.0	10.0–14.0	2.00–3.00
S31609	316H	0.04–0.10	2.00	0.045	0.030	1.00	16.0–18.0	10.0–14.0	2.00–3.00
S32100	321	0.08 ^E	2.00	0.045	0.030	1.00	17.0–19.0	9.0–12.0	—
S34700	347	0.08 ^E	2.00	0.045	0.030	1.00	17.0–19.0	9.0–12.0	—
S30908	309S	0.08	2.00	0.045	0.030	1.00	22.0–24.0	12.0–15.0	—
S31008	310S	0.08	2.00	0.045	0.030	1.00	24.0–26.0	19.0–22.0	—
Austenitic — High-Strength & Super Austenitic									
S20910	XM-19	0.06	4.0–6.0	0.045	0.030	1.00	20.5–23.5	11.5–13.5	1.50–3.00
S21800	—	0.10	7.0–9.0	0.060	0.030	3.5–4.5	16.0–18.0	8.0–9.0	—
N08367	—	0.030	2.00	0.040	0.030	1.00	20.0–22.0	23.5–25.5	6.0–7.0
S31254	6-Mo	0.020	1.00	0.030	0.010	0.80	19.5–20.5	17.5–18.5	6.0–6.5
S32654	654 SMO®	0.020	2.0–4.0	0.030	0.005	0.50	24.0–25.0	21.0–23.0	7.0–8.0
Duplex (Austenitic-Ferritic)									
S31803	—	0.030	2.00	0.030	0.020	1.00	21.0–23.0	4.5–6.5	2.5–3.5
S32205	2205	0.030	2.00	0.030	0.020	1.00	22.0–23.0	4.5–6.5	3.0–3.5
S32750	2507	0.030	1.20	0.035	0.020	0.80	24.0–26.0	6.0–8.0	3.0–5.0
S32760	—	0.030	1.00	0.030	0.010	1.00	24.0–26.0	6.0–8.0	3.0–4.0
Ferritic & Martensitic									
S43000	430	0.12	1.00	0.040	0.030	1.00	16.0–18.0	—	—

UNS	Type	C	Mn	P	S	Si	Cr	Ni	Mo
S44400	444	0.025	1.00	0.040	0.030	1.00	17.5–19.5	1.00	1.75–2.50
S41000	410	0.15	1.00	0.040	0.030	1.00	11.5–13.5	—	—
S41400	414	0.15	1.00	0.040	0.030	1.00	11.5–13.5	1.25–2.50	—
S43100	431	0.20	1.00	0.040	0.030	1.00	15.0–17.0	1.25–2.50	—

Notes: C = on request, max C 0.030–0.040 depending on size. E = see Supplementary Requirement S1. Residual Mo, Ti, Ni, Co, Ta, N and Cu need not be reported but must not exceed residual levels — substitution of one alloy type for another is prohibited. Full Table 1 (≈75 designations) per the standard.

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Mechanical Properties

Minimum room-temperature tensile properties per Table 2. Yield is determined by the 0.2 % offset method (A370). Hardness is measured midway between surface and center of the cross section.

UNS / Type	Condition	Tensile min, ksi [MPa]	Yield min, ksi [MPa]	Elong. 2 in. min, %	Brinell max
AUSTENITIC — STANDARD GRADES					
302, 304, 304H, 304LN, 309S/H/Cb, 310S/H/Cb, 316, 316H, 316Ti/Cb/N, 317, 321/H, 347/H, 348/H, ER308D	Annealed	75 [515]	30 [205]	30	—
304L, 316L	Annealed	70 [485]	25 [170]	30	—
304N, 316N	Annealed	80 [550]	35 [240]	30	—
AUSTENITIC — HIGH-STRENGTH & SUPER AUSTENITIC					
S20161	Annealed	125 [860]	50 [345]	40	311
XM-19 (S20910)	Annealed	100 [690]	55 [380]	35	293
XM-19 hot- rolled (to 2 in.)	Hot-rolled	135 [930]	105 [725]	20	—
XM-19 strain- hardened (to 1½ in.)	Strain- hardened	145 [1000]	125 [860]	12	—
S31254	Annealed	95 [655]	44 [305]	35	—
S32654	Annealed	109 [750]	62 [430]	40	250
S34565	Annealed	115 [795]	60 [415]	35	230
AUSTENITIC — STRAIN-HARDENED CONDITIONS (304/316 FAMILY)					
316 / 316L — Level 1	Strain- hardened	85 [585]	65 [450]	30	—
304 / 304L — Level 2, ≤2 in.	Strain- hardened	95 [655]	75 [515]	25	—
304 — Level 2,	Strain- hardened	90 [620]	65 [450]	30	—

UNS / Type	Condition	Tensile min, ksi [MPa]	Yield min, ksi [MPa]	Elong. 2 in. min, %	Brinell max
over 2 to 2½ in.					
304 — Level 2, over 2½ to 3 in.	Strain-hardened	80 [550]	55 [380]	30	—
DUPLEX GRADES					
S31803	Annealed	90 [620]	65 [450]	25	290
S32205 (2205)	Annealed	95 [655]	65 [450]	25	290
S32750 (2507), ≤2 in.	Annealed	116 [800]	80 [550]	15	310
S32750, over 2 in.	Annealed	110 [760]	75 [515]	15	310
S32760	Annealed	109 [750]	80 [550]	25	300
S39277	Annealed	118 [820]	85 [585]	25	293
FERRITIC GRADES					
405	Annealed	60 [415]	25 [170]	20	207
430, 439	Annealed	70 [485]	40 [275]	20	192
444	Annealed	60 [415]	45 [310]	20	217
XM-27 (S44627)	Annealed	65 [450]	40 [275]	45	217
MARTENSITIC GRADES					
403, 410 — Condition 1	Annealed	70 [485]	40 [275]	20	223
403, 410 — Condition 2	Tempered	110 [760]	85 [585]	15	269
403, 410 — Condition 3	Tempered	130 [895]	100 [690]	12	331
414	Tempered	115 [795]	90 [620]	15	321
431	Tempered	115 [795]	90 [620]	15	321

UNS / Type	Condition	Tensile min, ksi [MPa]	Yield min, ksi [MPa]	Elong. 2 in. min, %	Brinell m
S41500	Normalized + tempered	115 [795]	90 [620]	15	293
XM-30 (S41040)	Quenched + tempered	125 [860]	100 [690]	13	302

Notes: At least one room-temperature test per lot, from at least one bar or shape. Reduction of area must be met where listed but is not measured/reported unless the purchase order requires it. Martensitic material supplied annealed must still be **capable** of meeting hardened & tempered properties after heat treatment.



Strain-hardened strength is size-dependent

For Level 2 strain-hardened 304 and strain-hardened XM-19, minimum tensile/yield values **decrease as bar diameter increases**. Always check the size bracket applicable to your order — a 2¼ in. bar does not carry the same guaranteed strength as a 1½ in. bar in the same condition.

05

Grain Size — The H-Grade Signature Requirement

All austenitic grades are tested for average grain size (ASTM E112). This is the metallurgical feature that distinguishes A479 from general bar specs.



Standard H Grades

ASTM No. 6 or coarser required for 304H, 309H, 310H and 316H.



Stabilized H Grades

ASTM No. 7 or coarser required for 321H, 347H and 348H.



S32615 Special Case

Silicon-austenitic S32615: grain size **No. 3 or finer** (E112 comparison method, Plate 11).



Why grain size matters to buyers

Coarser grains improve **creep resistance at high temperature** — that's why H grades (built for >1000 °F / 540 °C service) specify a minimum coarseness. A non-H grade can be reclassified as its H-grade equivalent if it meets all H-grade chemistry, annealing temperature and grain-size

requirements — so the grain-size test report on non-H material has real commercial value (Supplementary Requirement S1).

06

Heat Treatment Response

Martensitic grades must respond to hardening heat treatment per Table 3 — test samples $\leq \frac{3}{8}$ in. [9.5 mm] section; temperature tolerance ± 25 °F [15 °C].

Type	Austenitizing Temp, °F [°C] min	Quenchant	HRC min
403	1750 [955]	Air	35
410	1750 [955]	Air	35
414	1750 [955]	Oil	42

General heat-treatment practice (solution annealing, tempering conditions, straightening rules) is governed by Specification A484/A484M.

07

Testing & Inspection

What the manufacturer verifies on every lot before shipment.



Tensile Test

- At least one room-temperature test per lot (≥ 1 bar/shape)
- Yield by 0.2 % offset method per A370
- Level 1/2 strain-hardened values size-bracketed



Hardness

- Brinell max per Table 2 by grade/condition
- Measured **midway between surface and center** of the cross section
- Key limits: 2205 → 290 HB max · 2507 → 310 HB max



Chemical Analysis

- Reported to the purchaser with each shipment
- Methods per A751
- Product analysis tolerances per A484 unless S3 invoked



Intergranular Corrosion

- All austenitic grades must be **capable** of passing IGC tests in as-shipped condition
- Sensitized specimens for 304L, 316L, 321, 347, 348 (Practice E, A262)
- Mandatory for alternative-method solution annealing (S2)



Grain Size (E112)

- All austenitic grades tested and reported
- H grades: No. 6 / No. 7 or coarser (see section 05)



Certification

- Manufacturer's certificate of compliance at shipment
- Report of all required results, positively relatable to the lot

08

Product Marking Codes

Heat-treated or strain-hardened material carries condition symbols after the grade designation (in addition to A484 marking). Reading the code tells you exactly what you received.

A**Annealed**

All families, annealed condition

S1**316 Level 1**

Strain-hardened Type 316

S2**316 Level 2**

Strain-hardened Type 316

H**Hot-Rolled XM-19**

Hot-rolled Type XM-19

S**Strain-Hardened XM-19**

Strain-hardened Type XM-19

ELT**S1 Compliant**

Meets Supplementary Requirement S1 (not needed for H grades)

D**Direct Quenched**

Solution annealed by direct quench (when S1 invoked)

T**Tempered Martensitic**

Type 414, S41500, XM-30 tempered

COND 1/2/3**403 & 410 Tempering**

Per tempering temperature used

09**Supplementary Requirements (S1–S5)**

Optional requirements that apply only when the purchaser invokes them in the order. For ASME Code service above 1000 °F [540 °C], S1 is effectively mandatory.

**S1 — High-Temperature Service**

- Required for ASME Code applications **above 1000 °F [540 °C]** unless an H grade is ordered
- Non-H material may be used as the H grade if it meets all H-grade chemistry, annealing temperature and grain-size requirements
- L grades allowed above 1000 °F per applicable ASME allowable-stress tables when grain size is No. 7 or coarser (reported on CTR)

**S2 — Corrosion Tests**

- Intergranular corrosion tests on sensitized specimens of 304L, 316L, 321, 347, 348
- Other austenitic grades: as-shipped condition specimens
- Tested per Practice E of A262



S3 — Product Analysis

- Manufacturer analysis on one bar per lot (A484 lot definition)
- Must meet Table 1; failure rejects the lot (individual-bar retest at manufacturer's option)
- Product-analysis tolerance provisions do not apply



S4 — High Cycle Fatigue Service

- Bars < 20 ft [6 m]: one end tested
- Bars ≥ 20 ft [6 m]: **both ends** tested



S5 — Optimum SCC Resistance

- Austenitic bars with solution annealing as the **final operation** — no subsequent cold drawing
- Straightening allowed only to meet A484 straightness, unless prohibited by purchaser

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Ordering Information

Specify everything the mill needs — incomplete orders are the #1 cause of delivery delays. Foundation requirements are in A484/A484M; A479 adds the items below.



Essential for Every Order

- ASTM A479 designation (or A479M for metric) — state "M" if metric units apply
- UNS number or type designation
- Condition: annealed / strain-hardened (level) / hot-rolled / tempered
- Dimensions: diameter/thickness × length, shape (round/square/hex/angle/tee/channel)
- Quantity (number of pieces or weight)
- Heat-treatment condition codes (A, S1/S2, H, S, T, COND 1/2/3)
- Certification: manufacturer's test report required



Specify When Applicable

- S1 — high-temperature ASME service (> 1000 °F / 540 °C)

- S2 — intergranular corrosion test
- S3 — product analysis per lot
- S4 — both-end testing for bars ≥ 20 ft
- S5 — optimum SCC resistance (no cold drawing after anneal)
- Grain-size report (mandatory test, reporting on CTR)
- Reduction-of-area measurement and reporting
- A262 corrosion test practice selection

ORDER EXAMPLE — ANNEALED 316L BAR FOR PRESSURE VESSEL

ASTM A479, UNS S31603 (Type 316L), Condition A (annealed), round bar 2.500 in. dia. $\times$ 20 ft random lengths, 5 000 lb, manufacturer's test report with grain size, S3 product analysis.

ORDER EXAMPLE — HIGH-TEMPERATURE 304H

ASTM A479, UNS S30409 (Type 304H), Condition A (annealed), round bar 1.500 in. dia. $\times$ 12 ft, 2 000 lb, grain size ASTM No. 6 or coarser per E112, certification per Section 9.

11 Key Takeaways

The six points that matter most when you source A479 material.

1

Pressure-vessel spec — not a general bar spec

A479 is built for boiler and pressure-vessel construction with ASME Code lineage (SA-479). If your part is in a coded vessel, this is your standard.

2

A484/A484M is the foundation

Ordering info, tolerances, workmanship and packaging all live in A484. Failure to meet A484 general requirements = non-conformance with A479.

3**H grades control grain size for creep**

304H/309H/310H/316H need ASTM No. 6 or coarser; 321H/347H/348H need No. 7 or coarser.
Coarser grains = better high-temperature creep strength.

4**Above 1000 °F? Invoke S1.**

For ASME Code service above 1000 °F [540 °C], either order an H grade or specify Supplementary Requirement S1 — the grain-size report also opens the path to reclassify non-H material as H.

5**Duplex = double yield, but watch the temperature**

2205/2507 deliver 65–80 ksi minimum yield — roughly double 316L — with chloride SCC resistance.
Best value when you can redesign for thinner sections.

6**Read the marking code**

A, S1, S2, H, S, ELT, D, T, COND 1/2/3 — the suffix after the grade tells you the exact delivery condition and confirms you got what you paid for.

Disclaimer — This guide is a condensed customer-oriented summary of ASTM A479/A479M (Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels). It does not replace the full standard. For purchase, inspection, and compliance decisions, always refer to the current official edition published by ASTM International.

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