

Super Duplex 1.4501 / F55

Material no. 1.4501 · X2CrNiMoCuWN25-7-4 · Super duplex stainless steel with W and Cu (Zeron® 100)

Material group: Super duplex stainless steel (Cr-Ni-Mo-N + W + Cu), PREN ≈ 41–43

Material no. (EN): 1.4501

EN designation: X2CrNiMoCuWN25-7-4

UNS / ASME grade: UNS S32760 · ASTM F55

Trade names: Zeron® 100, Sandvik SAF 2507®, Outokumpu 4501

ASTM / ASME equivalent: Pipes: A790 / A928 · Fittings: A815 UNS S32760 (WP-S32760) · Flanges: A182 F55

Service temperature: –50 °C to +280 °C (continuous) · above 280 °C embrittlement risk (475 °C embrittlement, σ-phase)

Standards (pipes): EN 10216-5 · ASTM A790 / A928

Standards (fittings): EN 10253-4 · ASTM A815 · ASME B16.9

Forms (Nirotec): Elbows · tees · reducers · caps · flanges · custom parts

1 Material Equivalents & Comparable Grades

National equivalents

Standard / region	Designation	Material no. / Grade	Remark
EN	X2CrNiMoCuWN25-7-4	1.4501	Current European designation
UNS	S32760	UNS S32760	ASTM/ASME designation
ASTM	F55	–	ASTM F55 grade
ASTM/ASME	A/SA 790 S32760	UNS S32760	Seamless / welded pipes
ASTM/ASME	A/SA 815 WP-S32760	UNS S32760	Buttweld fittings
ASTM/ASME	A/SA 182 F55	UNS S32760	Forgings, flanges
NORSOK	M-650 Type 25Cr	–	Norwegian offshore specification
Trade names	Zeron® 100, SAF 2507®	–	Common trade names

Alternative materials

Material	Material no.	Reference / use	Note
1.4410 / S32750	1.4410	Standard super duplex without W	Similar PREN, slightly lower CCT

Material	Material no.	Reference / use	Note
1.4462 / S31803	1.4462	Standard duplex 2205	Moderate requirements, lower cost
6Mo / 1.4529	1.4529	Fully austenitic	Better processability, less strength
Inconel 625	2.4856	Higher corrosion resistance	Extreme acids or > 280 °C

2 Chemical Composition

Composition in mass percent (%). Standard: ASTM A790 / EN 10216-5. 1.4501 / F55 is a super duplex stainless steel with additional W and Cu (Zeron® 100). PREN (Pitting Resistance Equivalent Number) ≥ 40 – the highest standard for offshore and seawater applications. The ferrite/austenite phase balance (target 30–60 % ferrite) is critical for properties.

Element	Symbol	Min. (heat)	Max. (heat)	Max. (product)	Function / remark
Carbon	C	–	0.030	0.030	Low-C limit, avoids precipitation
Silicon	Si	–	1.00	1.00	Limit
Manganese	Mn	–	1.00	1.00	Limit
Phosphorus	P	–	0.035	0.035	Impurity limit
Sulfur	S	–	0.015	0.015	Impurity limit
Chromium	Cr	24.0	26.0	26.0	Pitting / crevice resistance
Nickel	Ni	6.0	8.0	8.0	Austenite stabiliser
Molybdenum	Mo	3.0	4.0	4.0	Pitting resistance (PREN)
Nitrogen	N	0.20	0.30	0.30	Austenite stabiliser, strength
Copper	Cu	0.50	1.00	1.00	Acid resistance
Tungsten	W	0.50	1.00	1.00	Crevice corrosion resistance

3 Mechanical Properties

Solution annealed – minimum requirements (ASTM A790 / EN 10216-5)

1.4501 is solution annealed at 1100–1140 °C and rapidly quenched. Critical: PREN ≥ 40 , ferrite content 30–60 %, free from intermetallic phases.

Property	Symbol	Unit	Minimum value	Remark
Yield strength 0.2 %	Rp0.2	MPa	≥ 550	Solution annealed, $t \leq 50$ mm
Tensile strength	Rm	MPa	≥ 750	–
Elongation at fracture	A	%	≥ 25	Longitudinal specimens
Impact energy (–46 °C)	KV	J	≥ 45	Mean value, NORSOK requirement

Property	Symbol	Unit	Minimum value	Remark
Hardness	HRC	–	≤ 28	NACE MR0175 / ISO 15156
Ferrite content	–	%	30 – 60	Phase balance, ferritescope
PREN	–	–	≥ 40	Pitting Resistance Equivalent

Hot yield strength Rp0.2 in MPa (typical values per standard)

Temperature	20 °C	100 °C	150 °C	200 °C	250 °C	280 °C
Rp0.2 (MPa)	550	470	445	420	400	385

4 Physical Properties

Property	Symbol	20 °C	100 °C	200 °C	Unit
Density	ρ	7.80	7.78	7.74	g/cm ³
Modulus of elasticity	E	200	194	187	GPa
Thermal conductivity	λ	13	15	17	W/(m·K)
Coeff. thermal expansion	α	13.0	13.5	14.0	10 ⁻⁶ /K
Specific heat capacity	cp	482	500	525	J/(kg·K)

5 Corrosion Resistance

Medium / environment	Remark	Resistance
Seawater (flowing)	Outstanding, PREN ≥ 40, CCT > 40 °C	++
Sour gas (H ₂ S)	NACE MR0175 qualified	++
Stress-corrosion cracking (Cl ⁻)	Highly resistant	++
Sulphuric acid (H ₂ SO ₄)	Good resistance (Cu content helps)	++
Hydrochloric acid (HCl) dilute	Resistant at moderate concentrations	+
Phosphoric acid (H ₃ PO ₄)	Good resistance	+
Hot chloride-bearing solutions	Resistant, PREN ≥ 40	+
High temperature > 280 °C	σ -phase precipitation – embrittlement risk	o
Hydrofluoric acid (HF)	Not recommended	-
Concentrated oxidising acids	Not resistant	-

++ excellent resistance

+ good resistance

o limited resistance

- not resistant

1.4501 / F55 is the standard material for demanding offshore and seawater applications – combining strength, corrosion resistance and economy versus nickel-base alloys.

6 Typical Applications

Industry / plant	Typical application	Operating condition
Offshore oil & gas	Subsea piping, manifolds, umbilicals	Seawater, sour service
Topside offshore plants	Production piping, separators	NORSOK M-650, NACE MR0175
Seawater cooling systems	Pumps, piping, heat exchangers	Flowing seawater
Chemical industry	Acid-resistant vessels, heat exchangers	H ₂ SO ₄ , mixed acids
Pulp & paper	Bleaching plants	Chloride-bearing media
Desalination plants	High-salinity brines, evaporators	Aggressive brines

7 Forms Available at Nirotec

Component	Standard (EN)	Standard (ASME/ASTM)	Remark
Elbows	EN 10253-4	ASME B16.9 · A815 WP-S32760	LR/SR, 90°/45°, custom angles
Tees	EN 10253-4	ASME B16.9 · A815 WP-S32760	Equal and reducing branch
Reducers	EN 10253-4	ASME B16.9 · A815 WP-S32760	Concentric and eccentric
Caps	EN 10253-4	ASME B16.9 · A815 WP-S32760	Hemispherical caps
Weld neck flanges	EN 1092-1 Type 11	ASME B16.5 · A182 F55	PN 10 – PN 400 / Class 150 – 2500
Custom parts	Per drawing	Per drawing	Special components on request

8 Standards, Approvals & Codes

Standard / code	Title / application
EN 10216-5	Seamless tubes for pressure purposes – stainless and duplex
EN 10253-4	Butt-welding fittings – austenitic and duplex stainless steels
EN 1092-1	Flanges and their joints
ASTM A790 / A928	Seamless / welded pipes – duplex
ASTM A815	Buttweld fittings – ferritic-austenitic and duplex stainless steels
ASTM A182 F55	Forgings, flanges – duplex

Standard / code	Title / application
NORSOK M-650	Qualification of material manufacturers (offshore)
NACE MR0175 / ISO 15156	Materials for H ₂ S-containing environments
PED 2014/68/EU	Pressure Equipment Directive
ASME B31.3	Process piping

9 Processing Notes

Weldability

Parameter	Specification / recommendation	Remark
Preheat	Not required	Preheat actually harmful (phase precipitation)
Post-weld heat treatment	Generally not required	If required: solution anneal 1100–1140 °C
Filler metal	ER2594 / E2594-XX (AWS A5.9 / A5.4)	Over-alloyed with Ni (8–10 %) for austenite formation
Welding processes	GTAW, GMAW, plasma, SMAW	Low heat input (max. 1.5 kJ/mm)
Interpass temperature	≤ 150 °C	Strictly observe – phase precipitation
Shielding gas	Ar + 1–3 % N ₂	Avoid N loss at root side

- Delivery condition: solution annealed (1100–1140 °C) + water quenched – essential for phase balance
- Ferrite measurement with ferritescope per EN ISO 8249 in every inspection certificate (target 30–60 %)
- Identification per ASTM A790: heat no., 1.4501 / S32760 / F55, standard, dimensions
- Strictly < 280 °C continuous service – σ-phase precipitation leads to embrittlement
- Welding requires trained personnel and qualified WPS/WPQR – CCT test recommended

10 Inquiry & Contact

For a project-specific inquiry we ideally require:

- Standard and type (e.g. ASTM A815 WP-S32760 LR 90°)
- Dimensions: DN / NPS, wall thickness or schedule
- Required tests: ferrite content, PREN, NORSOK CCT (Critical Crevice Temperature)
- Quantity and required delivery date
- Required documentation (EN 10204 type 3.1 / 3.2, NDT, external inspection)
- Project-specific specification (NORSOK MDS, NACE MR0175, customer specifications)

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