

254 SMO®**High Performance Austenitic Welded Stainless Tubular Product****Characteristics**

Grade 254 SMO® is a Molybdenum and Nitrogen alloyed super austenitic stainless steel with low Carbon content. The high performance austenitic stainless steels such as 254 SMO® have a fully austenitic microstructure in the quench annealed condition.

Characteristic properties

- Very good resistance to uniform corrosion
- Good to exceptionally good resistance to pitting and crevice corrosion
- Very good resistance to stress corrosion cracking
- Very good formability

Dimensions

254 SMO® is considered a stock standard material for OSTP in selected production standards and dimension ranges.

Tubes, Pipes and Butt Weld Fittings

- OD: 21.3–1219.0 mm
- WT: 1.5–25.4 mm
- Lengths: up to 12 m

Tubes below 21.3 mm OD and tubes with wall thickness below 1.5 mm or length over 12 m on special request.

Executions**Tubes, Pipes and Butt Weld Fittings**

- Welded with- or without filler metal
- Unannealed, pickled
- Solution annealed and pickled
- With – or Without BCW (Bead Cold Work) – Tubes Only
- Bevelled ends according to standards

Corrosion resistance

Grade 254 SMO® possesses excellent resistance to general corrosion, SCC, pitting corrosion and crevice corrosion. It has similar resistance to sea water conditions as the Super-Duplex 2507 grade, and has hence been widely used in offshore oil & gas and sea water desalination.

Product standards**Europe**

- EN 10217-7: Welded steel tubes for pressure purposes
 - Technical delivery conditions
 - Part 7: Stainless steel tubes
- EN 10296-2: Welded circular steel tubes for mechanical and general engineering purposes
 - Technical delivery conditions
 - Part 2: Stainless steel
- EN 10253-3: Butt-welding pipe fittings
 - Part 3: Wrought austenitic and austenitic-ferritic (Duplex) stainless steels without specific inspection requirements.
- EN 10253-4: Butt-welding pipe fittings
 - Part 4: Wrought austenitic and austenitic-ferritic (Duplex) stainless steels with specific inspection requirements.

**USA**

- ASTM A 249: Welded Austenitic steel boiler, super-heater, heat-exchanger and condenser tubes.
- ASTM A 269: Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- ASTM A 312: Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- ASTM A 358: Electric-Fusion-Welded Austenitic Cr-Ni Stainless Steel Pipe for High-Temperature Service and General Applications
- ASTM A 409: Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
- ASTM A 403: Wrought austenitic stainless steel piping fittings
- ASTM A 774: As-welded wrought austenitic stainless steel fittings for general corrosive service at low and moderate temperatures

Pressure vessel requirements**Europe**

The Pressure Equipment Directive PED regulates the use of welded stainless steel pipe and fittings in most European countries. OSTP fulfils the Directive, and is an approved manufacturer of welded stainless steel tubular products.

Outside Europe

Pressure vessel regulations are authorized to ASME. ASME Section VIII, Division 1, Table UHA-23, shows design values for tube and pipe manufactured and tested according to ASME SA-249 and SA-312 respectively. ASME B31.1 Power Piping and ASME B31.3 Process Piping prescribes design and design stress values for approved pipe materials.

Norway

NORSOK is a Norwegian standard that regulates the use of materials in some offshore applications. OSTP is an approved manufacturer of UNS S31254 pipe and butt weld fittings based on NORSOK requirements.

Fabrication**Welding**

Common welding methods for tubular products are:

- MMA, SMAW (Shielded Metal Arc Welding)
- TIG, GTAW (Gas Tungsten Arc Welding)
- MIG, MAG, GMAW (Gas Metal Arc Welding)
- PAW (Plasma Arc Welding)
- FCAW (Flux-Corded Arc Welding)
- SAW (Submerged Arc Welding)

General filler recommendation for steel grade 254 SMO® can be found in the table below. Welding without filler metal not followed by post weld heat treatment, will reduce the corrosion resistance of the weld, and is therefore not recommended. The base of the shielding and welding gases should consist of pure Ar with additions of 2–3% Nitrogen and 2–3% Hydrogen, in order to get optimal penetration and corrosion resistance. As root gas the recommendation is pure Ar or an gas mix of 90% N₂ and 10% H₂ (so called Formier gas). More welding information can be found in Outokumpu Welding Handbook.

Cold forming

Since the yield strength is higher than for standard austenitic grades, a higher initial force is necessary in operations such as bending or expanding tubes into tube sheets.

Hot forming

Grade 254 SMO® is slightly harder at higher temperatures than austenitic standard grades. Forming at temperatures in the range 1000–1200°C does not require any post heat treatment, if the operation is followed by a reasonable fast cooling, (>600°C/min).

Heat treatment

Normal annealing temperature is 1150–1200°C followed by rapid cooling to at least 700°C. At temperatures between 800–900°C, inter metallic phases that impair the properties will form within a few minutes.

Applications

Due to high levels of chromium, molybdenum, and nitrogen, 254 SMO® is especially suited for high-chloride environments such as brackish water, sea-water, pulp mill bleach plants, and other high-chloride process streams.

Pipe systems within:

- Offshore
- Chemical and petrochemical
- Hydrometallurgy
- Desalination
- Oil & gas

Design

The allowable design values are about 50% higher than those for standard austenitic steels. This means that the possibility of designing thinner walls can save costs in material, transport, welding and maintenance. Please use our Press Calculation Tool on www.ostp.biz for design purposes.

General filler recommendation for high performance austenitic stainless steels

Outokumpu	EN	ASTM / UNS	Welding consumables	
			Covered electrodes ISO 3581 / ISO 14172	Wires ISO 14343 / ISO 18274
904L	1.4539	N08904	20 25 5 CuL	20 25 5 CuL
254 SMO®	1.4547	S31254	Ni Cr 21 Mo Fe Nb / Ni Cr 25 Mo 16R or P54*	Ni Cr 22 Mo 9 Nb
4565	1.4565	S34565	Ni Cr 21 Mo Fe Nb / Ni Cr 25 Mo 16R or P54*	Ni Cr 22 Mo 9 Nb

Weld factor

Type of weld process and NDT	EN 13480-3		ASME B31		
	EN 10217-7 / EN 10253-4	EN 10296-2 / EN 10253-3	A 269	A 312 / A 774	A 358 / A 403
EFW, 100% ET	1.0	-	0.8	0.8	0.8
EFW, 100% RT	1.0	-	1.0	1.0	1.0
EFW, spot RT	-	0.85	0.9	0.9	0.9
EFW, double butt	-	0.7	0.85	0.85	0.85
EFW, single butt	-	0.7	0.8	0.8	0.8

EFW = Electric Fusion Welded ET = Eddy Current Test RT = Radiographic Test

The joint coefficient (z used in EN standards) or Joint quality factor (Ej, used in ASME standards) is used for calculation of the wall thickness for welded tubes.

The type of welding process, amount and type of NDT decide the factor.

Chemical composition, % (Typical values)

Outokumpu	EN	ASTM	Cr	Ni	Mo	N	PRE*
4307	1.4307	304L	18.1	8.3	-	-	18
4404	1.4404	316L	17.2	10.1	2.1	-	24
4432	1.4432	316L	16.9	10.7	2.6	-	25
904L	1.4539	N08904	20	25	4.3	-	34
254 SMO®	1.4547	S31254	20	18	6.1	0.20	43
4565	1.4565	S34565	24	17	4.5	0.45	46

* PRE = % Cr + 3.3% Mo + 16% N (The formula is used as a ranking tool to estimate pitting corrosion resistance in the material).

Mechanical properties (At room temperature)

Outokumpu	EN	ASTM	Min values acc. to EN 10028-7:2007									Min values according to ASTM A240-10		
			R _{p0.2} , MPa			R _m , MPa			A ₈₀ , %			R _{p0.2} , MPa	R _m , MPa	A ₅ , %
			P	H	C	P	H	C	P	H	C			
4307	1.4307	304L	200	200	220	500	520	520	45	45	45	170	485	40
4404	1.4404	316L	220	220	240	520	530	530	45	40	40	170	485	40
4432	1.4432	316L	220	220	240	520	550	550	45	40	40	170	485	40
904L	1.4539	N08904	220	220	240	520	530	530	35	35	35	220	490	35
254 SMO®	1.4547	S31254	300	300	320	650	650	650	40	35	35	310	655	35
4565	1.4565	S34565	420*	420*	420*	800*	800*	800*	30*	30*	30*	415	795	35

* Min values according to EN 10088-4:2009

P = Hot rolled plate

H = Hot rolled strip

C = Cold rolled coil and strip

Physical properties

Outokumpu	EN	ASTM	Density, g/cm ³	Modulus of elasticity, GPa	Poisson's ratio $\nu = -\epsilon_{trans} / \epsilon_{longitudinal}$	Average linear expansion at RT - 100°C x10 ⁻⁶ / °C
4307	1.4307	304L	18.1	200	0.3	16.0
4404	1.4404	316L	17.2	200	0.3	16.0
4432	1.4432	316L	16.9	200	0.3	16.0
904L	1.4539	N08904	20	200	0.3	16.0
254 SMO®	1.4547	S31254	20	200	0.3	16.0
4565	1.4565	S34565	24	200	0.3	16.0

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OSTP is a joint-venture between Tubinoxia and Outokumpu Group. OSTP manufactures the broadest range of stainless steel tubular products:

PROCESS PIPES

- Jakobstad, Finland
- Riyadh, Saudi Arabia

HEAVY WALL PIPES

- Storfors, Sweden

BUTT WELDED FITTINGS

- Örnsköldsvik, Sweden
- Jakobstad, Finland

PROCESS EQUIPMENT

- ÖMV, Örnsköldsvik, Sweden

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