Stainless steels for high service temperatures

Outokumpu Therma range

outokumpu
high performance stainless steel

outokumpu.com/therma

We believe in a world that lasts forever

Outokumpu is a global leader in the advanced materials business, creating stainless steels that are efficient, long lasting, and recyclable. A strong customer focus, sustainability, and technical excellence are at the heart of everything we do.

As an open and approachable company, our customers rely on our advice to help them select products that will deliver the best long-term performance for their needs.

With over a century of innovation behind us and some of the best minds in the business, we continue to develop pioneering materials to meet the demands of tomorrow.

The durability of stainless steel means that it is not only the best, but also the most economically sustainable choice for a wide range of applications. All of our products are made from an average of 85% recycled material and are fully recyclable at the end of their lifecycles.

Together with our customers and partners, we are building a world that lasts forever.

Courtesy of Torresol Energy.

Stay up to date on our latest innovations, follow market trends, and get inspired by success stories – subscribe to our magazines and newsletters **outokumpu.com/newsletter**

The inside view

For high service temperatures (> 550 °C).

Not only has Outokumpu been producing stainless steel for over a century, we also invented the heat resistant MA (micro-alloyed) stainless steels. Our legacy of innovation and consistent quality means that we have the right product for every application.

By grouping our products into ranges based on performance rather than stainless steel type we aim to make choosing the best product for your application easier. The Therma range stainless steels are designed for applications with service temperatures above 550 °C/1020 °F. These products give you better oxidation and high temperature corrosion resistance as well as long-term creep resistance.

We have decades of experience and knowledge of high-temperature applications and can support and advise you on choosing the optimum product. The Therma range contains both commodity and special heat resisting grades.

> “ Therma range stainless steels are designed for applications with service temperatures above 550 °C/1020 °F.

Our Therma MA grades give you a longer product lifecycle compared to other products like Therma 309S/4833 and Therma 310S/4845. Therma MA grades have good abrasion resistance, making them suitable for use in the cement and other heavy industries. MA grades also have significantly higher mechanical strength than Therma 309S/4833 and Therma 310S/4845. This means you can use thinner gauges for example in furnaces to increase efficiency and savings on material costs, or use the same thickness with higher loads to increase productivity.


Thérèse Sterneland, Outokumpu

The Therma range products are readily available around the globe and are delivered from mills and service centers that are well known for their quality and on-time delivery accuracy. You can depend on Outokumpu stainless steels to reliably and consistently meet the specifications that your application demands.

Choosing the right product

Key products

Therma 253 MA

A stainless steel with excellent oxidation and creep resistance in cyclic conditions that is best employed in temperatures up to 1150 °C/2100 °F. There is a slight susceptibility to embrittlement during continuous operation at 600–850 °C/1110–1560 °F.

Typical applications

- Oil industry equipment
- Conveyor belts
- Refractory anchors
- Expansion bellows
- Radiant tubes, tube shields, and valves and flanges
- Rotary kilns
- Exhaust manifolds
- Power generation applications
- Cyclone dip tubes
- Impact separators
- Bell furnaces and muffle furnaces
- Automotive components
- Heat treatment trays
- Dampers
- Recuperator tubes
- Large-scale bakery ovens

Product forms

C, H, P, B, R, S, T

Therma 310S/4845

A product with very good oxidation resistance in general and good oxidation resistance in mildly cyclic conditions that is best employed in temperatures up to 1050 °C/1920 °F. There is a slight susceptibility to embrittlement during continuous operation at 600–900 °C/1110–1652 °F.

Typical applications

- Furnace equipment
- Oil industry equipment
- Heat treatment baskets
- Heat exchangers
- Steam boilers
- Thermowells
- Automotive components
- Valves and flanges

Product forms

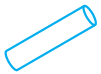
C, H, P, B, R, S, T

Product forms

C
Cold rolled coil and sheet

H
Hot rolled coil and sheet

P
Quarto plate



B
Bar

R
Wire rod

S
Semifinished (bloom, billet, ingot & slab)

T
Pipe

Therma range applications

Typical applications for the Therma range are grouped by steel type:

Ferritic products with resistance to sulfur containing hot gases and lower thermal expansion

- Chemical industry (drums)
- Power industry (coal burners)
- Metalworking industry (heat treatment boxes)
- Furnace technology (walls, doors)

Austenitic products with resistance to carburizing and nitriding/low oxygen hot gas and with higher creep strength

- Iron, steel, and non-ferrous metals industries
- Energy conversion plants
- Cement industry
- Automotive exhaust applications
- Heat treatment industry

Contact us at **outokumpu.com/contacts** to find out which of our products is right for your next project.

If you need a grade with high creep resistance, choose a nitrogen alloyed heat resistant grade.

Resistance to sulfur containing hot gases and with lower thermal expansion

Outokumpu name	Typical applications	Product forms
Therma 4713 A ferritic low-alloyed stainless steel best employed at 550–800 °C/1020–1470 °F when you need higher mechanical loading compared to other ferritic grades. Offers good resistance against sulfur attack compared to nickel-alloyed grades.	• Furnace equipment • Air heaters • Annealing boxes • Conveyor belts • Thermowells	C, H, P, S
Therma 4724 A ferritic low-alloyed product with improved oxidation resistance in temperatures up to 850 °C/1560 °F.	• Furnace equipment • Thermal boiler components • Grids • Burner nozzles • Conveyor belts • Thermowells	C, H, P, S
Therma 4742 A ferritic stainless steel with very good oxidation resistance in temperatures up to 1000 °C/1830 °F, but which begins to be subject to embrittlement at temperatures above 950 °C/1740 °F.	• Grids • Burner nozzles • Conveyor belts • Chains • Machine parts • Cement processing equipment	C, H, P, S

Resistance to carburizing and nitriding/low oxygen hot gas and with higher creep strength

Outokumpu name	Typical applications	Product forms
Therma 304H/4948 An austenitic Core 304/4301 variant with improved high-temperature creep strength that is best employed in temperatures up to 750 °C/1380 °F. Offers good formability and weldability.	• Pipes • Pressure vessels • Valves and flanges	C, H, P, B, R, S, T
Therma 321H/4878 An austenitic heat resisting stainless steel with comparable wet corrosion resistance to Core 321/4541 that is best employed in temperatures up to 850 °C/1560 °F.	• Furnace equipment • Case hardening boxes • Valves and flanges	C, H, P, B, R, S, T

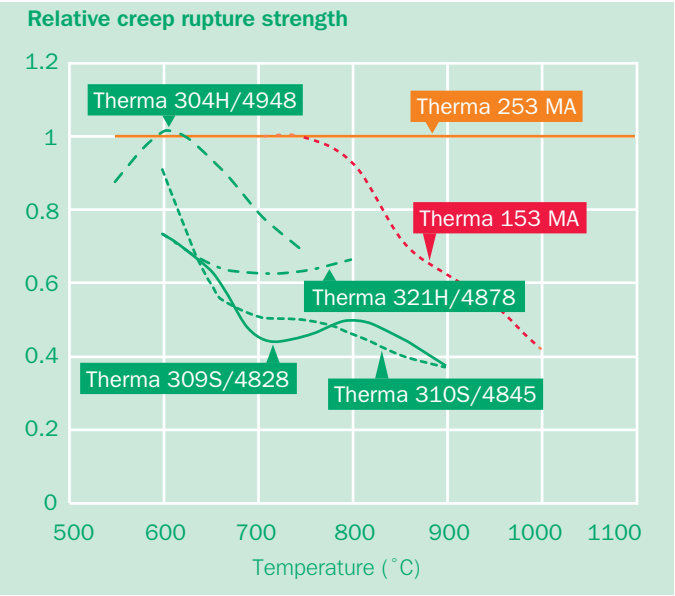
Outokumpu name	Typical applications	Product forms
Therma 347H An austenitic heat resisting stainless steel product with excellent long-term creep resistance at 550–600 °C/1020–1110 °F and comparable wet corrosion resistance to Core 347/4550.	• Oil refineries • Fired heater tubes • Boiler casings • Pressure and reactor vessels • Welded pipes • Fittings • Stack liners • Tanks • Furnace heating elements • Valves and flanges	C, H, P, B, R, S, T
Therma 4828 An austenitic heat resisting stainless steel with improved oxidation resistance in temperatures up to 1000 °C/1830 °F. There is a slight susceptibility to embrittlement during continuous operation at 600–850 °C/1110–1560 °F.	• Furnace equipment • Annealing and hardening boxes • Air heaters • Exhaust systems • Automotive components • Valves and flanges	C, H, P, B, S
Therma 309S/4833 An austenitic stainless steel with improved oxidation resistance in temperatures up to 1000 °C/1830 °F. There is a slight susceptibility to embrittlement during continuous operation at 600–850 °C/1110–1560 °F.	• Furnace equipment • Annealing boxes • Thermowells • Baffle plates • Pots for quenching salt • Valves and flanges	C, H, P, B, R, S, T
Therma 153 MA An austenitic stainless steel with excellent oxidation and creep resistance in cyclic conditions that is best employed in temperatures up to 1000 °C/1830 °F. This product has an excellent resistance to embrittlement.	• Recuperators • Conveyor belts • Expansion bellows • Power generation applications • Cyclone dip tubes • Bell and muffle furnaces • Automotive components • Tube shields, valves, flanges • Heat treatment trays • Dampers	C, P, R, S, T
Therma 314/4841 An austenitic heat resisting stainless steel with excellent oxidation resistance in temperatures up to 1150 °C/2100 °F. There is a high susceptibility to embrittlement during continuous operation at 600–950 °C/1110–1740 °F.	• Furnace equipment • Superheater suspensions • Enameling grates and hardening boxes • Valves and flanges	C, H, P, B, R, S

Product performance comparison

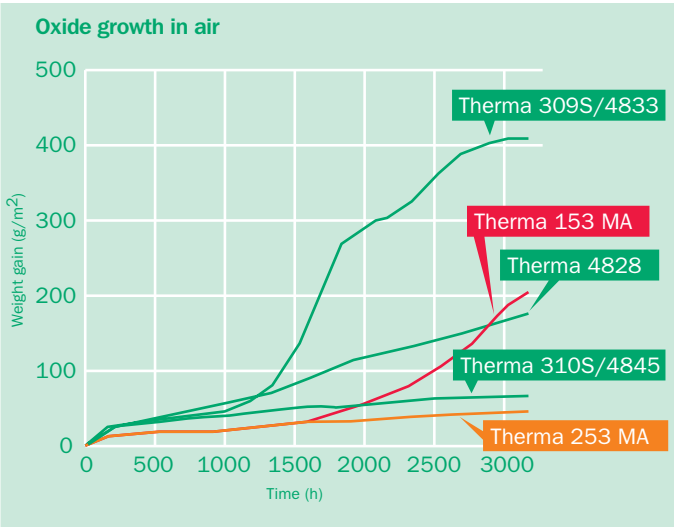
Outokumpu name	EN	ASTM		Max. service temperature $T_{a\ max}$ for air (EN 10095)	Creep rupture strength	Structural stability	Resistance to hot gases			
							Sulfur containing		Carburizing	Nitriding/ low oxygen
		Type	UNS				Reducing	Oxidizing		
Key products										
Therma 253 MA	1.4835	–	S30815	1150°C/2100°F	★★★★★	★★★	★★	★★★★	★★★	★★★
Therma 310S/4845	1.4845	310S	S31008	1050°C/1920°F	★★★	★★	★	★★★	★★★	★★★★
Resistance to sulfur containing hot gases, lower thermal expansion										
Therma 4713	1.4713	–	–	800°C/1470°F	★	★★★★	★★★★	★★★★	★	★
Therma 4724	1.4724	–	–	850°C/1560°F	★	★★★	★★★★	★★★★	★	★
Therma 4742	1.4742	–	–	1000°C/1830°F	★	★	★★★★★	★★★★★	★	★
Resistance to carburizing and nitriding/low oxygen hot gas, higher creep strength										
Therma 304H/4948	1.4948	304H	S30409	750°C/1380°F	★★★	★★★	★★	★★★	★	★
Therma 321H/4878	1.4878	321H	–	850°C/1560°F	★★★	★★★★	★★	★★★	★	★
Therma 347H	–	347H	S34709	700°C/1290°F	★★★	★★★★	★★	★★★	★	★
Therma 4828	1.4828	–	–	1000°C/1830°F	★★★	★★	★	★★★	★★	★★★
Therma 309S/4833	1.4833	309S	S30908	1000°C/1830°F	★★★	★★★	★	★★★	★★	★★★
Therma 153 MA	1.4818	–	S30415	1050°C/1920°F	★★★★	★★★★	★★	★★★★	★★	★★
Therma 4841/314	1.4841	314	S31400	1150°C/2100°F	★★★	★	★	★★★	★★★★	★★★★

Note: The more stars a product has, the better its properties in that category.

If your stainless steel will be used at temperatures below 600 °C/1100 °F, austenitic grades from the Core range should also be considered.



100,000 hours creep rupture strength, relative to Therma 253 MA.



Oxide growth in air at 1000 °C/1830 °F, 165 hour cycles for austenitic high temperature steels.

Therma 310S/4845 and Therma 314/4841 rings collapsed due to their own weight. 1000 °C/1830 °F, 35 hours, 1 mm/0.04 in thickness.

Low nickel grades will generally resist high temperature corrosion caused by sulfur better than grades with more nickel.

Product properties

Therma range

High service temperatures (> 550 °C)

Steel designations				Performance		Typical chemical composition, % by mass					
		ASTM									
Outokumpu name	EN	Type	UNS	Max service temp. (°C) [1]	Grade family	C	Cr	Ni	Mo	N	Others
Therma 253 MA	1.4835	–	S30815	1150	A	0.09	21.0	11.0	–	0.17	Si Ce
Therma 310S/4845	1.4845	310S	S31008	1050	A	0.05	25.5	19.1	–	–	–
Resistance to sulfur containing hot gases, lower thermal expansion											
Therma 4713	1.4713	–	–	800	F	0.06	6.5	–	–	–	Al Si
Therma 4724	1.4724	–	–	850	F	0.07	12.5	–	–	–	Al Si
Therma 4742	1.4742	–	–	1000	F	0.07	17.5	–	–	–	Al Si
Resistance to carburizing and nitriding/low oxygen hot gas, higher creep strength											
Therma 304H/4948	1.4948	304H	S30409	750	A	0.05	18.1	8.3	–	–	–
Therma 321H/4878	1.4878	321H	–	850	A	0.05	17.3	9.1	–	–	Ti
Therma 347H	–	347H	S34709	700	A	0.05	17.5	9.5	–	–	Nb
Therma 4828	1.4828	–	–	1000	A	0.05	19.3	11.2	–	–	Si
Therma 309S/4833	1.4833	309S	S30908	1000	A	0.06	22.3	12.3	–	–	–
Therma 153 MA	1.4818	–	S30415	1050	A	0.05	18.5	9.1	–	0.15	Si Ce
Therma 314/4841	1.4841	314	S31400	1150	A	0.06	24.3	19.2	–	–	Si

[1] In dry air acc. EN 10095.

Note: Chemical compositions are Outokumpu typical values.
For more information please see **steelfinder.outokumpu.com**

Replacing Therma 309S/4833 by Therma 153 MA

Challenge

Avoiding creep deformation of the lower part of the inner cover of a bell furnace.

Environment

Temperature: 770–850 °C/1410–1560 °F
Atmosphere: 92% N_2 + 8% H_2
Heating/cooling: electric/air

Solution

Therma 153 MA provides the required creep strength and a protective oxide adherent during temperature cycles. It brings toughness and ductility at room temperature allowing repair work if necessary.

Benefits of Therma MA grades

- Good microstructural stability
- Extraordinary creep strength
- Excellent oxidation resistance
- Resistance to erosive/abrasive environments

Looking for expert help to choose the best grade for your next project? Please contact us by **outokumpu.com/contacts**

Working towards forever.

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: clean energy, clean water, and efficient infrastructure. Because we believe in a world that lasts forever.

1555EN-GB:2. May 2016.

outokumpu classic

Moda	Core	Supra
Mildly corrosive environments	Corrosive environments	Highly corrosive environments

outokumpu pro

Forta	Ultra	Dura	Therma	Prodec	Deco
Duplex & other high strength	Extremely corrosive environments	High hardness	High service temperatures	Improved machinability	Special surfaces

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high performance stainless steel

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