outokumpu
high performance stainless steel

Therma 253 MA

EN 1.4835, ASTM UNS S30815

General characteristics

Therma 253 MA is 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.

A common feature of Outokumpu high temperature steels is that they are designed primarily for use at temperatures exceeding ~550 °C, i.e. in the temperature range where creep strength as a rule is the dimensioning factor and where HT corrosion occurs. Optimizing steels for high temperatures limits their resistance to aqueous corrosion.

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 for the steel industry
- Large-scale bakery ovens

Products & dimensions

Cold rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
2BB	Bright-pickled	0.80-3.00	30-1300	0.80-3.00	600-1300
2C	Cold rolled, heat treated	0.50-12.00	30-2000	0.80-3.00	600-1300
2D	Cold rolled, heat treated, pickled	0.80-3.00	30-1300	0.80-3.00	600-1300
2E	Cold rolled, heat treated, mech. desc. pickled	0.50-6.00	30-2040	0.50-6.00	300-2040
2G	Ground	0.80-3.00	30-1300	0.80-3.00	600-1300
2J	Brushed or dull polished	0.80-3.00	30-1300	0.80-3.00	600-1300
2R	Cold rolled, bright annealed	0.05-3.00	3-1500	0.50-3.00	350-1500

Continous hot rolled products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1C	Hot rolled, heat treated, not descaled	2.50-10.00	50-1455		
1D	Hot rolled, heat treated, pickled	4.50-10.00	50-2040	4.50-10.00	300-2040
1U	Black hot rolled	2.50-10.00	50-1455		

Quarto plate products, available dimensions (mm)

Surface finish		Coil / Strip		Plate / Sheet	
		Thickness	Width	Thickness	Width
1D	Hot rolled, heat treated, pickled			6.00-50.00	400-3000

Chemical composition

The typical chemical composition for this grade is given in the table below, together with composition limits given for the product according to different standards. The required standard will be fully met as specified on the order.

The chemical composition is given as % by mass.

	C	Mn	Cr	Ni	Mo	N	Other
Typical	**0.09**		**21.0**	**11.0**		**0.17**	**Si:1.6 Ce:0.05**
ASME II A SA-240	0.05-0.10	≤0.80	20.0-22.0	10.0-12.0		0.14-0.20	Si:1.4-2.0 Ce:0.03-0.08
ASTM A240	0.05-0.10	≤0.80	20.0-22.0	10.0-12.0		0.14-0.20	Si:1.40-2.00 Ce:0.03-0.08
EN 10095	0.05-0.12	≤1.00	20.00-22.00	10.00-12.00		0.12-0.20	Si:1.40-2.50 Ce:0.03-0.08
IS 6911	0.05-0.10	≤0.80	20.0-22.0	10.0-12.0	≤0.70	0.14-0.20	Si:1.40-2.00 Ce:0.03-0.08

Corrosion resistance

Aqueous corrosion

Since most high-temperature materials are optimized with regard to strength and corrosion resistance at elevated temperatures, their resistance to electrochemical low-temperature corrosion may be less satisfactory. Components made of high-temperature material should therefore be designed and operated so that acid condensates are not formed, or at least so that any such condensates are drained away.

High-temperature corrosion

The resistance of a material to high-temperature corrosion is in many cases dependent on its ability to form a protective oxide layer. In a reducing atmosphere, when such a layer cannot be created (or maintained), the corrosion resistance of the material will be determined by its alloy content.

Oxidation

When a material is exposed to an oxidizing environment at elevated temperatures, a more or less protective oxide layer will be formed on its surface. Even if oxidation is seldom the primary cause of high-temperature corrosion failures, the oxidation behavior is important, because the properties of the oxide layer will determine the resistance to attack by other aggressive elements in the environment.The oxide growth rate increases with increasing temperature until the rate of oxidation becomes unacceptably high or until the oxide layer begins to crack and spall off, i.e. the scaling temperature is reached. The alloying elements that are most beneficial for oxidation resistance are chromium, silicon, and aluminum. A positive effect has also been achieved with small additions of so-called (re)active elements, e.g. yttrium, hafnium, and rare earth metals (REM, e.g. Ce and La). These affect the oxide growth so that the formed layer will be thinner, tougher, and more adherent, and thus more protective. This is especially beneficial in conditions with varying temperatures.

For more information on corrosion resistance, please refer to the Outokumpu Corrosion Handbook or contact our corrosion experts.

Pitting corrosion resistance		Crevice corrosion resistance
PRE	CPT	CCT
24		

Pitting Resistance Equivalent (PRE) is calculated using the following formula: PRE = %Cr + 3.3 x %Mo + 16 x %N
Corrosion Pitting Temperature (CPT) as measured in the Avesta Cell (ASTM G 150), in a 1M NaCl solution (35,000 ppm or mg/l chloride ions).
Critical Crevice Corrosion Temperature (CCT) is obtained by laboratory tests according to ASTM G 48 Method F

Mechanical properties

The mechanical strength at elevated temperatures for Therma 253 MA are presented in the table below (minimum values).

º C	50	100	150	200	250	300	350	400	450	500	550	600	700
$R_{p0.2}$ [MPa]	280	230	198	185	176	170	165	160	155	150	145	140	130
R_m [MPa]	630	585	560	545	538	535	533	530	515	495	472	445	360

At higher temperatures, the creep strength is the dimensioning factor. Creep deformation strength and creep rupture strength for Therma 253 MA are presented in the table below. Values are according to EN 10095.

º C	500	550	600	650	700	750	800	850	900	950	1000	1050	1100
Creep rupture strength $R_{km,10\,000}$ [MPa]	-	250	157	98	63	41	27	18	13	9.5	7	5.5	4
Creep rupture strength $R_{km,\,100\,000}$ [MPa]	-	160	88	55	35	22	15	11	8	5.5	4	3	2.3
Creep deformation strength $R_{A1,10\,000}$ [MPa]	-	230	126	74	45	28	19	14	10	7	5	3.5	2.5
Creep deformation strength $R_{A1,\,100\,000}$ [MPa]	-	150	80	45	26	16	11	8	6	4.5	3	2	1.2

Mechanical properties at room temperature are shown in the table below.

Cold rolled coil and sheet	$R_{p0.2}$ MPa	$R_{p1.0}$ MPa	R_m MPa	Elongation[1)] %	Impact strength J	Rockwell	HB	HV
Typical (thickness 1 mm)	**415**	**450**	**750**	**65**				
ASME II A SA-240	≥ 310		≥ 600				≤ 217	

ASTM A240	≥ 310		≥ 600			≤ 95HRB	≤ 217	
EN 10095	≥ 310	≥ 350	650 - 850	≥ 40				
IS 6911	≥ 310		≥ 600			≤ 95HRB	≤ 217	

Hot rolled coil and sheet	**$R_{p0.2}$ MPa**	**$R_{p1.0}$ MPa**	**R_m MPa**	**Elongation[1)] %**	**Impact strength J**	**Rockwell**	**HB**	**HV**
Typical (thickness 4 mm)								
ASME II A SA-240	≥ 310		≥ 600				≤ 217	
ASTM A240	≥ 310		≥ 600				≤ 217	
EN 10095	≥ 310	≥ 350	650 - 850	≥ 40				
IS 6911	≥ 310		≥ 600			≤ 95HRB	≤ 217	

Hot rolled quarto plate	**$R_{p0.2}$ MPa**	**$R_{p1.0}$ MPa**	**R_m MPa**	**Elongation[1)] %**	**Impact strength J**	**Rockwell**	**HB**	**HV**
Typical (thickness 15 mm)	**370**	**410**	**700**	**50**				
ASME II A SA-240	≥ 310		≥ 600			≤ 95HRB	≤ 217	
ASTM A240	≥ 310		≥ 600			≤ 95HRB	≤ 217	
EN 10095	≥ 310	≥ 350	650 - 850	≥ 40				
IS 6911	≥ 310		≥ 600			≤ 95HRB	≤ 217	

Wire rod	**$R_{p0.2}$ MPa**	**$R_{p1.0}$ MPa**	**R_m MPa**	**Elongation[1)] %**	**Impact strength J**	**Rockwell**	**HB**	**HV**
Typical	**370**	**410**	**700**	**50**				

[1)]Elongation according to EN standard:
A_{80} for thickness below 3 mm.
A for thickness = 3 mm.
Elongation according to ASTM standard $A_{2''}$ or A_{50}.

Physical properties

Data according to EN 10088

Density kg/dm^3	**Modulus of elasticity** GPa	**Thermal exp. at 100 °C** 10^{-6}/°C	**Thermal conductivity** W/m°C	**Thermal capacity** J/kg°C	**Electrical resistance** µΩm	**Magnetizable**
7.8	200	17,0	15	500	0.85	No

Fabrication

Like other austenitic steels, Therma 253 MA can also be formed in the cold condition. However, as a result of the relatively high nitrogen content, the mechanical strength is higher, and consequently greater deformation forces will be required.

Machining

The relatively high hardness of austenitic steels and their ability to strain harden must be taken into consideration in connection with machining. For more detailed data on machining, please contact Outokumpu.

Welding

Thrma 253 MA has very good weldability. To ensure weld metal properties (e.g. strength, corrosion resistance) equivalent to those of the parent metal, a filler material with a matching composition should preferably be used. In some cases, however, a differing composition may improve e.g. weldability or structural stability. Gas shielded welding has resulted in the best creep properties for welds. To facilitate the use of Therma 253 MA at the highest temperature range, TIG, plasma, or MAG processes should be used. Welding with MAG may require modern pulse equipment, and the use of special shielding gases containing Ar, He, and O_2/CO_2 to facilitate good arc stability and improved fluidity.

More detailed information concerning welding procedures can be obtained from the Outokumpu Welding Handbook, available from our sales offices.

Standards & approvals

The most commonly used international product standards are given in the table below.

Standard	Designation
ASME SA-240M Code Sect. II. Part A	UNS S30815 / 253MA
ASTM A240/A240M	UNS S30815 / 253MA
EN 10095	1.4835
IS 6911, AMENDMENT NO. 2	ISS 308Ce

Contacts & Enquiries

Contact your nearest sales office

www.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.

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