153 MA™ - High Temperature Welded Stainless Tubular Products

Characteristics

153 MA™ is a grade combining excellent service properties at high temperatures with ease of fabrication. It provides superior service to Grade 309. The inclusion of high silicon, nitrogen and cerium contents gives the steel good oxide stability, high elevated temperature strength and excellent resistance to sigma phase precipitation. The austenitic structure gives this grade excellent toughness, even down to cryogenic temperatures. Optimal performance is achieved at 600-950°C, and the scaling temperature is 1050°C.
Its specific characteristics are:

- Austenitic micro structure
- High mechanical strength at elevated temperatures
- Low sensitivity to form sigma phase
- High resistance to:
  - oxidation
  - high temperature corrosion
- Good ductility and weldability

Dimensions

153 MA™ is not a stock standard grade, but can be manufactured in most common standard sizes within the product range of Outokumpu Stainless Tubular Products.

Tubes, Pipes and Butt Weld Fittings

- OD: 17.2-1219.0 mm
- WT: 1.5-25.4 mm
- Lengths: up to 12 m

Heat exchanger tubes

- OD: 12.0-114.3 mm
- WT: 0.6-4.0 mm
- Lengths: up to 15 m

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 Worked)
- Bevelled ends according to standards

Heat exchanger tubes

- No BCW for laser welded tubes, h max = 0.15 mm
- Tig welded tubes are BCW
- Solution annealed and pickled

Heat and corrosion resistance

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. Optimising steels for high temperatures has meant that their resistance to wet corrosion has been limited. For more details about 153 MA™ please see Outokumpu Datasheet 1011 EN-GB:4 “High Temperature Austenitic Stainless Steel”. Also see Outokumpu Corrosion Handbook for more information.

Product standards

Europe

- EN 10296-2 Welded SS tubes for general purposes

USA

- ASTM A 249 Welded Austenitic SS Heat Exchanger Tubes
- ASTM A 312 Welded and seamless Austenitic SS Pipes
- ASTM A 358 EF Welded Austenitic Pipe with filler metal

Pressure vessel approvals

Europe

No approvals for welded tubes as present.

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, SA-312 and SA-358 respectively. Creep strength values for 153 MA™ are tabled on next page.

Design

The creep strength is much higher than those for similar high temperature austenitic steels. This means that the possibility of designing thinner walls can save costs in material, transport, welding and maintenance.

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)
- FCAW (Flux-Cored Arc Welding)
- PAW (Plasma Arc Welding)
- Submerged Arc Welding (SAW)

General filler recommendation for steel grade 153 MA™ 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 % Hydrogen, in order to get optimal penetration and corrosion resistance.

Cold forming

Excellent cold forming properties. The same properties as for other standard austenitic stainless steels.

Hot forming

153 MA™ is slightly harder at higher temperatures than austenitic standard grades. Forming at temperatures in the range 900-1150°C does not require any post heat treatment, if the operation is followed by a reasonable fast cooling.

Heat treatment

1020-1100°C followed by rapid cooling.

Applications

Heat exchanger tubes in processes like:

- Hot air dryer
- Hydrocarbon gases, painting
- Preheating of exhaust gas
- Recuperators
- Super heater tubes, fluidised bed.
- Waste combustion
- Heat treatment

General filler recommendation for High temperature austenitic stainless steel

			Welding consumables	
			Covered electrodes	Wires
Outokumpu	EN	ASTM / UNS	ISO 3581 / ISO 14172	ISO 14343 / ISO 18274
4948	1.4948	304H	19 9	308
153 MA™	**1.4818**	**S30415**	**21 10 N or 253 MA-NF***	**21 10 N**
4833	1.4833	309S	22 12 or 253 MA-NF*	21 10 N
253 MA®	1.4835	S30815	21 10 N or 253 MA-NF*	21 10 N
4845	1.4845	310S	25 20 or 21 10N	25 20

* Avesta Welding designation

Chemical composition, %

Grade	C	Cr	Ni	Si	N	Ce
153 MA™	**0.04-0.06**	**18.0-19.0**	**9.0-10.0**	**1.0-2.0**	**0.12-0.18**	**0.03-0.08**
EN 1.4818	0.04-0.08	18.0-20.0	9.0-11.0	1.0-2.0	0.12-0.20	0.03-0.08
UNS S30415	0.04-0.06	18.0-19.0	9.0-10.0	1.0-2.0	0.12-0.18	0.03-0.08

Design

	EN 10095					
Temp. °C	min $R_{p1.0}$ MPa	R_m MPa	$R_{km\ 10\ 000}$ MPa	$R_{km\ 100\ 000}$ MPa	$R_{A1\ 10\ 000}$ MPa	$R_{A1\ 100\ 000}$ MPa
50	280	570	-	-	-	-
100	235	525	-	-	-	-
200	195	485	-	-	-	-
300	180	475	-	-	-	-
400	170	470	-	-	-	-
500	160	435	-	-	-	-
550	155	410	250	160	200	135
600	150	385	157	88	126	80
650	142	340	98	55	74	45
700	135	300	63	35	42	26
750	-	-	41	22	25	15
800	-	-	25	14	15	9
850	-	-	16	8	8.5	5
900	-	-	10	5	5	3
950	-	-	6.5	3	3	1.8
1000	-	-	4	1.7	1.7	1

Mechanical properties

At 20° C	EN 1.4818	ASTM/UNS S30415
min $R_{p0.2}$ (MPa)	290	290
min $R_{p1.0}$ (MPa)	230	-
min R_m (MPa)	600	600
Elongation A_5 %	40	35
Hardness HB_{max}	210	RB 96

Physical properties

	Temperature°C	20	600	800	1000
Density	kg/dm	7.8	-	-	-
Modulus of elasticity	Gpa	200	155	135	120
Linear expansion	(20-t)x10^{-6}/°C	-	18.5	19.0	19.5
Thermal conductivity	W/m,°C	15.0	22.5	25.5	28.0
Thermal capacity	J/kg,°C	500	600	630	660
Electric resistivity	nΩm	0.84	1.37	1.43	1.45

Activating Your Ideas

Outokumpu is a global leader in stainless steel with the vision to be the undisputed number one. Customers in a wide range of industries use our stainless steel and services worldwide. Being fully recyclable, maintenance-free, as well as very strong and durable material, stainless steel is one of the key building blocks for sustainable future.

What makes Outokumpu special is total customer focus – all the way, from R&D to delivery. You have the idea. We offer world-class stainless steel, technical know-how and support. We activate your ideas.

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