ROLLED ALLOYS
The Better Metal People™

DATA SHEET
RA 253 MA®
UNS S30815

THE GLOBAL LEADER IN SPECIALTY ALLOYS

HEAT RESISTANT ALLOYS

RA 253 MA DATA SHEET

Contents

Features and Specifications....1

Performance Profile....2

Oxidation....2

Sulfidation....2

Hot Salt Corrosion....2

Carburization....2

Creep-Rupture Properties....3

Physical Properties....6

Mechanical Properties....6

Fabrication....7

Forming....9

Machining....9

Applications....10

ROLLED ALLOYS
The Better Metal People

FEATURES

- Excellent oxidation resistance through 2000 °F
- High creep-rupture strength
- Good weldability
- Alkali salt hot corrosion resistance

APPLICATIONS

- Coal burners in power boilers
- Fluidized bed combustor cyclones
- Kilns, rotary calciners
- Furnace fans and dampers
- Superheater tube hangers
- Recuperators
- Thermal oxidizers
- Radiant tubes for steel coil and aluminum annealing
- Expansion bellows
- Land based gas turbine components

CHEMICAL COMPOSITION, %

	Min	Max
Chromium (Cr)	20.0	22.0
Nickel (Ni)	10.0	12.0
Silicon (Si)	1.40	2.00
Carbon (C)	0.05	0.10
Nitrogen (N)	0.14	0.20
Cerium (Ce)	0.03	0.08
Manganese (Mn)	—	0.80
Phosphorus (P)	—	0.040
Sulphur (S)	—	0.030
Iron (Fe)	balance	

SPECIFICATIONS

UNS S30815 EN 1.4835
ASME Section IX P-No. 8, Group No. 2
ASME
SA-182(F45), SA-213, SA-240,
SA-249, SA-312, SA358, SA-409, SA-479
ASTM
A167, A 182(F45), A 213, A 240,
A 249, A 276, A 312, A 358, A 409, A 473,
A 479, A 480, A 813 and A 814

PERFORMANCE PROFILE

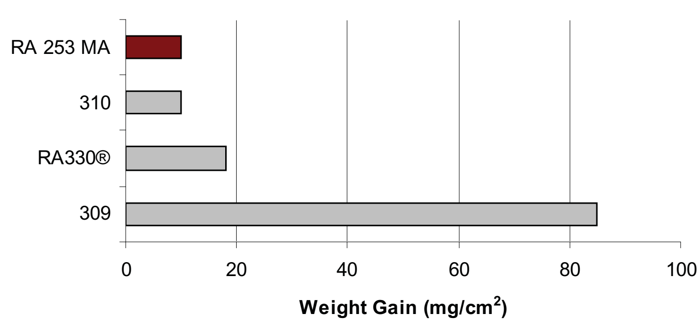
RA 253 MA is a lean austenitic heat resistant alloy with high strength and outstanding oxidation resistance. It offers an excellent combination of high creep strength along with excellent resistance to oxidation, sulfidation, and erosion at high temperatures in an alloy containing just 11% nickel. Because of its lean chemistry, RA 253 MA is very economical compared to most heat resistant alloys.

RA 253 MA obtains its heat resistant properties by tight control of micro alloy additions. The use of cerium in combination with silicon results in superior oxidation resistance to 2000°F 1093°C). Nitrogen, carbon, and cerium combine to provide creep rupture strength that is double that of type 310 stainless at 1600°F (871°C).

OXIDATION

RA 253 MA has exceptional oxidation resistance up to about 2000°F (1093°C). Above this temperature, its oxidation resistance drops off. A combination of rare earths and silicon is responsible for the excellent oxidation resistance of this 21%Cr alloy. The rare earths increase diffusion rate of the silicon to the scale-metal interface. This promotes the development of a continuous SiO_2 subscale, which in turn slows further oxide growth. Rare earth metals also improve adhesion and elasticity of the oxide scale, even under cyclic conditions. These rare earths, primarily cerium, increase the number of nucleation sites for the oxide. This results in a fine grained chromia and silica scale.

2000°F Cyclic Oxidation Testing



SULFIDATION

RA 253 MA has good resistance to hot SO_2 bearing atmospheres, meaning sulfidation under oxidizing conditions. However, RA 253 MA is not resistant to reducing sulfidizing atmospheres, when sulfur is present as H_2S. Note that even though the atmosphere may be oxidizing, the partial pressure of oxygen can be extremely low under solid sulfate deposits. Local sulfidation attack under the deposit can then occur.

Test samples exposed to an atmosphere containing 13.6% SO_2 at 1850°F (1010°C) for 1860 hours exhibited the following depth of intergranular oxidation and sulfidation.

Table 1 - Sulfidation Resistance

Alloy	Depth of Atttack	
RA 253 MA	8 mils	(0.20 mm)
RA333®	8 mils	(0.20 mm)
309 Stainless	18 mils	(0.46 mm)
310 Stainless	20 mils	(0.51 mm)
RA330®	24 mils	(0.61 mm)

HOT SALT CORROSION

Sodium and potassium salts cause hot corrosion of heat resistant alloys. Traditionally the most resistant alloys have been considered to be those highest in nickel. Exposure in salts for heat treating high speed steel indicate that RA 253 MA may be comparable to alloy 600.

Table 2 – Hot Salt Corrosion

Alloy	Nickel % Weight	Depth of IGA mils (mm)
RA 253 MA	11	6.9 (0.18 mm)
Alloy 600	76	7.5 (0.19 mm)
309 Stainless	13	12.5 (0.32 mm)
RA330	35	13.8 (0.35 mm)

Plate samples exposed 210-252 cycles in preheat salts 1300 and 1500°F (704 and (816°C), high heat salt 2200°F (1200°C), quench in 1100°F (593°C) salt.

Metallic pots for neutral heat treating salts are commonly made of 309 or RA330. The service life of the pot is primarily determined by maintenance, not alloy. Pots must be desludged regularly. When changing pots, every bit of old spilled salt must be removed from the furnace refractory.

CARBURIZATION

RA 253 MA has only fair resistance to carburization. Carburization resistance is primarily dependent on the nickel content of a material. Service experience has shown 309 stainless to be slightly better.

Coupons were exposed for 15 weeks of simulated bake cycles 1700—1950°F (930-1065°C) in “green mix” used for production of carbon electrodes. Room temperature tensile tests showed the following ductility:

Table 3 – Carburization Resistance

Alloy	Nickel Weight %	Retention of Ductility, % Reduction of Area
RA 253 MA	11	0.5%
302B Stainless	9	Nil Ductility
800H	32	1.4%
RA330	35	16.6%

CREEP-RUPTURE PROPERTIES

RA 253 MA maintains excellent creep rupture strength up to its upper use limit of 2000°F. Additions of nitrogen, carbon, and cerium all enhance its high temperature strength in comparison to 309 or 310 stainless steels. Above 1600°F, RA 253 MA offers twice the creep strength of types 309 and 310 stainless steel and is actually stronger than the 35% nickel alloy RA330. Over 2.6 million hours of creep and rupture testing were used to generate the graphs and tables in this section. Some tests were run as long as 30,000 hours.

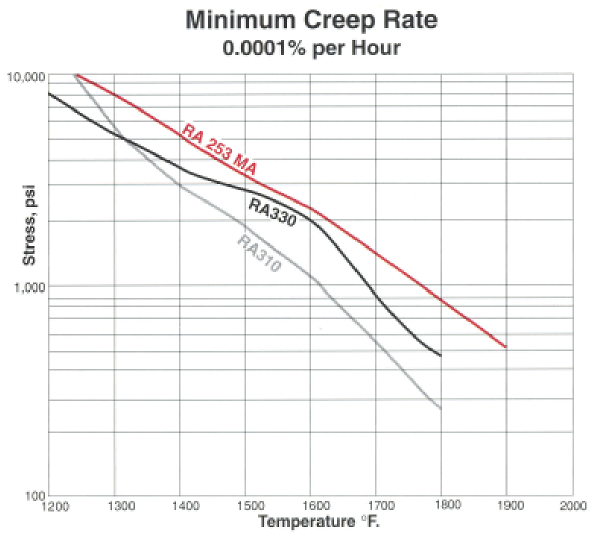


Table 4 - Average Stress for Minimum Creep Rate

Temperature	0.0001%/hr ksi (MPa)	0.00001%/hr ksi (MPa)
1100°F (593°C)	18 (125)	12 (82.7)
1200°F (649°C)	11.6 (80)	8.2 (56.5)
1300°F (704°C)	7.7 (53.1)	5.7 (39.3)
1400°F (760°C)	5.0 (34.5)	3.8 (26.2)
1500°F (816°C)	3.35 (23.1)	2.55 (17.6)
1600°F (871°C)	2.3 (15.9)	1.75 (12.1)
1700°F (927°C)	1.5 (10.3)	1.15 (7.93)
1800°F (982°C)	0.89 (6.14)	0.55 (3.79)
1900°F (1036°C)	0.49 (3.39)	0.32 (2.21)*
2000°F (1093°C)	0.25 (1.72)*	0.15 (1.03)*

*extrapolated

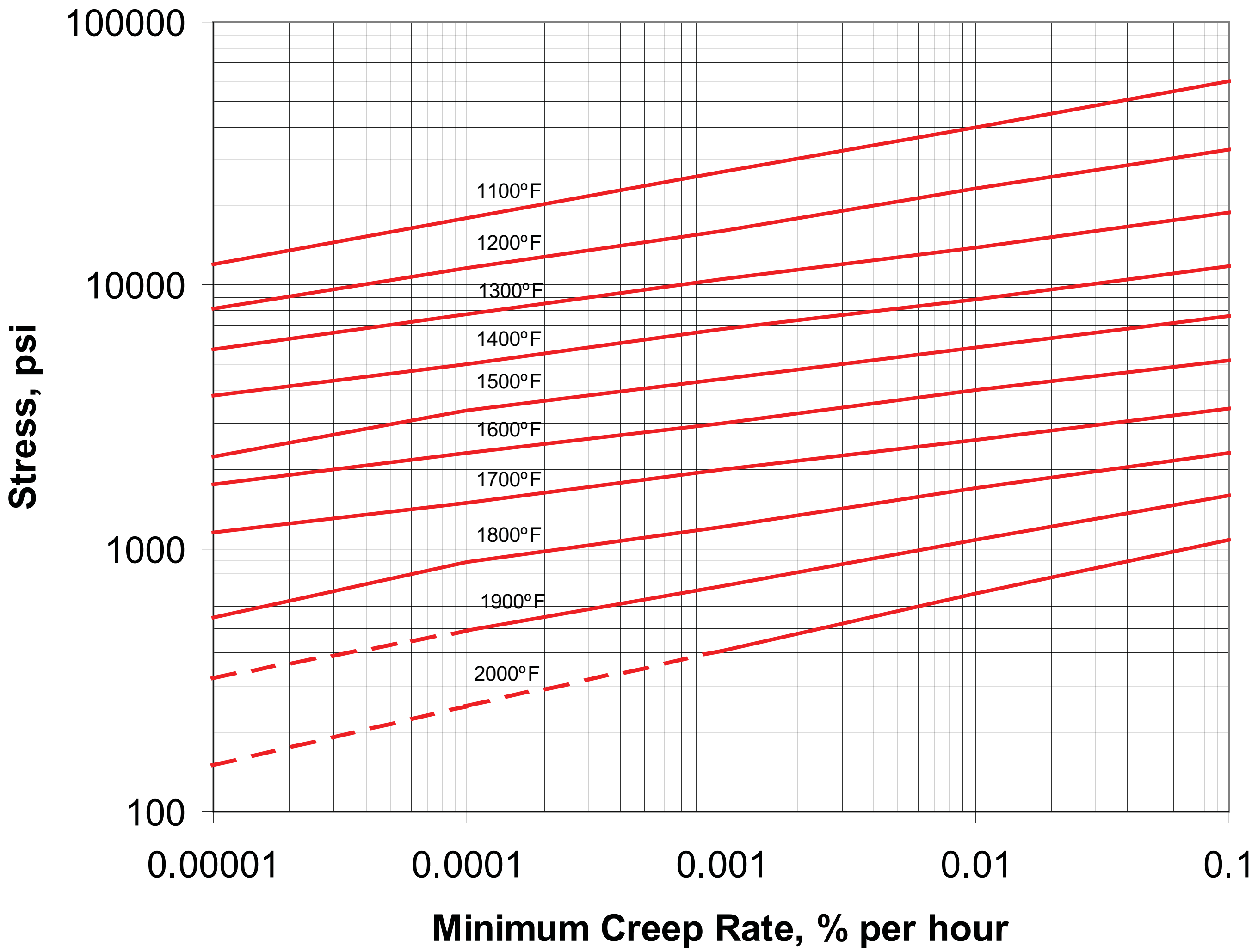
Figures 1 & 2 - RA 253 MA dip tubes in a circulating fluidized bed boiler. These tubes are roughly 8-1/2 feet in diameter and 23 feet long. This power plant originally used type 310 stainless, which required replacement due to distortion shown below after 2 to 3 years of service. RA 253 MA tubes average 5 to 6 years life. These photos were taken after 6 years of service. Operating temperatures are typically 1600°F.

Table 5 - Average Stress to Rupture in Indicated Times

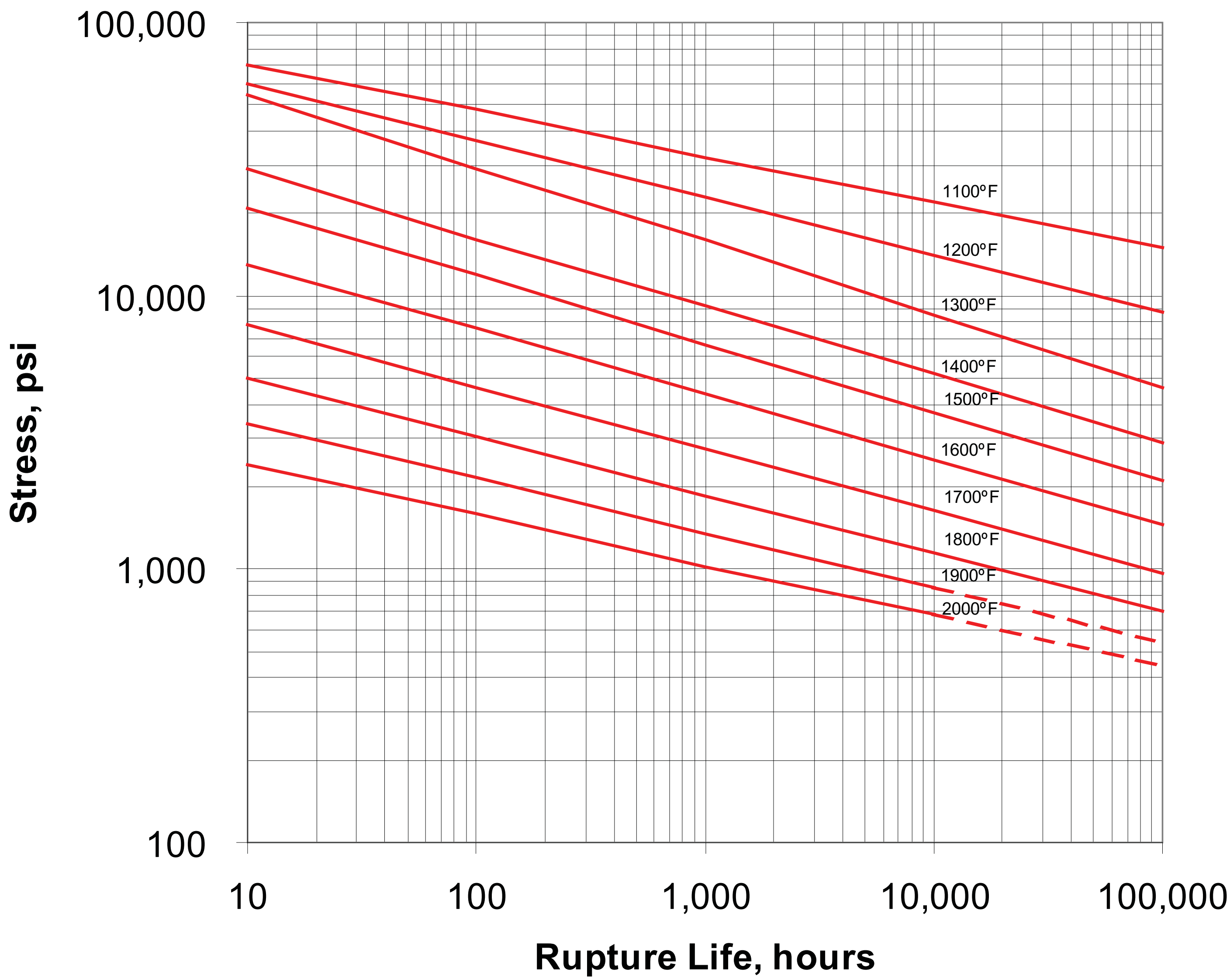
Temperature	1000 hrs ksi (MPa)	10,000 hrs ksi (MPa)	100,000 hrs ksi, (MPa)
1100°F (593°C)	32 (221)	22 (152)	15 (103)
1200°F (649°C)	23 (159)	14 (96.5)	8.7 (60.0)
1300°F (704°C)	16 (110)	8.5 (58.6)	4.6 (31.7)
1400°F (760°C)	9.2 (63.4)	5.2 (35.9)	2.9 (20.0)
1500°F (816°C)	6.6 (45.5)	3.75 (25.9)	2.1 (14.5)
1600°F (871°C)	4.4 (30.3)	2.50 (17.2)	1.45 (10.0)
1700°F (927°C)	2.8 (19.0)	1.65 (11.4)	0.97 (6.69)
1800°F (982°C)	1.85 (12.8)	1.15 (7.93)	0.7 (4.83)
1900°F (1036°C)	1.35 (9.31)	0.86 (5.93)	0.54 (3.72)*
2000°F (1093°C)	1.03 (7.03)	0.68 (4.69)	0.44 (3.03)*

*extrapolated

AVERAGE STRESS FOR MINIMUM CREEP RATE



AVERAGE STRESS TO RUPTURE IN INDICATED TIMES



SIGMA PHASE EMBRITTLEMENT

Like other high chromium austenitic stainless steels, RA 253 MA, loses room temperature toughness and ductility after long term exposure to the 1100—1600°F (600—870°C) temperature range. The effect is primarily on room temperature properties. While operating in the creep-rupture range the metal will have greater ductility and toughness. Charpy impact values after aging at intermediate temperatures are provided in Table 6 for RA 253 MA alloy and type 310 stainless steel for reference.

Table 6 – Aged Charpy V-notch Impact Properties

Alloy	Aging Temperature	Time Hours	Impact Strength ft-lbs (J)
RA 253 MA	Annealed Condition	-	110 (149)
	1292 (700 °C)	20,000	3 (4)
	1472 (800 °C)	20,000	4 (5)
	1652 °F (900 °C)*	20,000	42 (57)
310 Stainless	Annealed Condition	-	69 (94)
	1292 (700 °C)	20,000	3 (4)
	1472 (800 °C)	20,000	3 (4)
	1652 °F (900 °C)	20,000	27 (36)

At 1652 °F, charpy values increased versus 10,000 hr exposure

PHYSICAL PROPERTIES

Table 7 – Physical Properties

Density	0.282 lb/in^3	7800 kg/m^3
Melting Range	2500-2610°F	1370-1435°C
Magnetic Permeability	μ = 1.01 at H = 1000 Oersted	

Table 8 – Coefficient of Thermal Expansion (CTE) from 68°F (20°C)

Temperature	in/in °F x 10^{-6}	m/m °Cx10^{-6}
200 °F (93 °C)	9.06	16.3
400 °F (204 °C)	9.34	16.8
600 °F (316 °C)	9.59	17.3
800 °F (427 °C)	9.81	17.7
1000 °F (538 °C)	9.97	17.9
1200 °F (649 °C)	10.14	18.3
1400 °F (760 °C)	10.3	18.5
1600 °F (871 °C)	10.5	18.9
1800 °F 982 °C)	10.8	19.4

Table 9 – Thermal Conductivity & Specific Heat

	Thermal Conductivity		Specific Heat	
Temperature	Btu●ft/ft^2●hr °F	W/m●K	Btu/lb● °F	J/Kg ●K
68 °F (20 °C)	8.38	14.5	0.105	440
400 °F (204 °C)	10.1	17.5	0.117	490
800 °F (427 °C)	11.7	20.2	0.130	544
1200 °F (649 °C)	13.0	22.5	0.142	595
1400 °F (760 °C)	14.0	24.2	0.149	624
1800 °F (982 °C)	16.6	28.7	0.164	687

Table 10 – Electrical Resistivity

Temperature	ohm●circ mil/ft	microhm●m
68 °F (20 °C)	505	0.84
400 °F (204 °C)	622	1.03
800 °F (427 °C)	745	1.24
1200 °F (649 °C)	830	1.38
1400 °F (760 °C)	851	1.41
1800 °F (982 °C)	871	1.45

MECHANICAL PROPERTIES

Table 11 - Minimum Tensile Properties (ASTM A 240)

Ultimate Tensile Strength	87,000 psi	(600 MPa)
0.2% Yield Strength	45,000 psi	(310 MPa)
Elongation, %		40
Reduction of Area, %		50
Hardness		95 Rockwell B (Max)

RA 253 MA witch's hat used in a pulverized coal boiler at a U.S. paper mill to protect an ash chute coming off the boiler. RA 253 MA was selected for its resistance to oxidation, sulfidation, and abrasion resistance in the process temperatures.

Table 12 - Typical Elevated Temperature Tensile Properties

Temperature	Ultimate Tensile Strength ksi (Mpa)	0.2% Yield Strength ksi (Mpa)	Elongation %	Reduction of Area %
122 (50)	96.2 (663)	44.2 (305)	51	68
212 (100)	90.2 (622)	39.3 (271)	48	65
392 (200)	83.8 (578)	32.2 (222)	46	65
572 (300)	82.4 (568)	29.3 (202)	46	64
752 (400)	79.7 (550)	29.1 (201)	46	60
932 (500)	75.7 (522)	25.5 (176)	44	62
1112 (600)	69.0 (476)	24.2 (167)	43	63
1292 (700)	56.4 (389)	23.0 (159)	44	58
1472 (800)	36.9 (254)	21.5 (148)	-	76
1562 (850)	24.8 (171)	14.6 (101)	-	88
1652 (900)	18.9 (130)	11.6 (80)	-	92
1832 (1000)	10.8 (74.5)	6.2 (42.7)	-	97
2012 (1100)	9.4 (64.8)	4.0 (27.6)	-	97
2192 (1200)	3.7 (25.5)	2.0 (13.8)	-	99

Data for 1562°F (850°C) and above are from a single heat, other data is an average of 2 to 5 heats

Note: Above approximately 1000°F (540°C), short time tensile properties are note a suitable criteria for design. At these temperatures, metals are not elastic and deform slowly over time. Design calculations should utilize time dependent properties such as creep or rupture data.

Table 13 – Poisson's Ratio

Temperature	psi x 10^{-6}	GPa
68°F (20°C)	29.0	200
400°F (204°C)	26.8	185
800°F (427°C)	24.4	168
1200°F (649°C)	21.7	150
1400°F (760°C)	20.2	139
1800°F (982°C)	17.6	121

FABRICATION

Welding

RA 253 MA should be welded with matching welding consumables, which are referred to as RA 253 MA. These are carried in inventory by Rolled Alloys in bare wire for GMAW and GTAW processes, covered electrodes for SMAW, and flux core wire for the FCAW process. Use of the matching filler ensures that the weld joint matches the strength and corrosion resistance of the RA 253 MA base metal.

RA 253 MA base metal is listed in ASME Section IX as P group 8.

Preheating and post-heating are not required for welding RA 253 MA. The chemistry of RA 253 MA welding wire and covered electrodes is balanced to contain about 4 to 12 Ferrite Number. This ferrite provides RA 253 MA weld fillers excellent resistance to hot cracking. In that respect, RA 253 MA behaves like other stainless weld fillers, such as 309. The unique addition of cerium to RA 253 MA, both in the base metal and in the weld fillers, is to enhance oxidation resistance. Cerium also makes the weld bead appear a little rough. This is characteristic of weld fillers
containing rare earths and is not amenable to improvement by welding procedure. While this has not been a problem in service, a few customers prefer to weld RA 253 MA with RA333® weld fillers.

Interpass temperatures should be kept below 300°F to minimize the likelihood of solidification cracking. Maintaining a low welding heat input with a maximum of 1.5 kJ/mm is a suggested.

Shielded Metal Arc Welding (SMAW)

RA 253 MA-17 AC/DC titania electrodes (UNS W30816) may be used with either alternating current or with direct current. For DC welding use reverse polarity (electrode positive). Maintain the arc length as short as possible. A short arc minimizes loss of cerium through the arc and improves penetration. Stringer beads with only a slight weave, not more than twice the electrode diameter are preferred. Starts and craters should be filled in to minimize the possibility of cracking.

All welding flux must be removed from each deposit, between passes and after the final pass. Residual welding flux may corrode the material when placed in high temperature service.

Table 14 – Typical SMAW Parameters

Electrode Diameter	Amperage	Volts
3/32 inch	45-70	24-30
1/8 inch	70-110	24-30
5-32 inch	100-140	24-30

The lower end of the current range is used for out-of-position welding.

Table 15 – Typical Chemistry SMAW weld deposit, Weight %

C	Si	Mn	Cr	Ni	N
0.08	1.5	0.7	22.0	10.5	0.18

RA 253 MA electrodes and flux cored wires are packaged in hermetically sealed containers to assure freedom from contamination and moisture absorption. After opening, electrodes should be stored at 150 to 250°F to prevent the coating from absorbing moisture. Electrodes damaged by exposure to atmospheric humidity should be reconditioned for two to four hours at 500-600°F. It is important to heat and cool slowly. Porosity and excessive weld spatter may result if electrodes are not completely dry.

Flux Cored Arc Welding (FCAW)

The recommended shielding gas for flux cored welding with RA 253 MA consumables is a mixture of 75% argon and 25% carbon dioxide. Shield gas flow rate should be 40 cubic feet per hour. Wire extension should be 0.5 to 1 inch. Unused wire should be stored in a moisture resistant holding environment to prevent moisture pickup by the flux.

Table 16 – Typical Chemistry FCAW weld deposit , Weight %

C	Ce	Si	Mn	Cr	Ni	N
0.06	0.005	1.4	1.0	22.0	10.0	0.15

Table 17 – Typical FCAW Parameters – Flat/Horizontal Position

Wire Diameter	Amperage	Volts
0.045	100-270	23-35

Gas Metal Arc Welding (GMAW)

Table 18 – Suggested Shielding Gases for GMAW

Transfer Mode	Shielding Gas Composition
Spray Arc	100% Argon
	81% Argon, 18% Helium, 1% Carbon Dioxide
Globular/Short Circuit	75% Argon, 25% Helium
	90% Argon, 7.5% Helium, 2.5% Carbon Dioxide
	81% Argon, 18% Helium, 1% Carbon Dioxide
Out of Position	68% Argon, 30% Helium, 2% Carbon Dioxide

** Do not use 98%Ar 2%O_2 for welding RA 253 MA. Never use 75% Ar 25%CO_2 for any stainless or heat resistant alloy using the GMAW process.*

Table 19 – Typical Chemistry GMAW weld deposit, Weight %

C	Si	Mn	Cr	Ni	N
0.07	1.6	0.6	21.0	10.0	0.15

GAS TUNGSTEN ARC WELDING (GTAW)

100% argon shielding gas is preferred for manual GTAW. Helium may be added to increase speed in automatic welding. Electrodes should be 2% thoriated tungsten (AWS EWTh-2) with direct current straight polarity (electrode negative). For good arc control, grind the electrode tip to a 30 to 60 degree point, with a small flat at the tip. Grind lines should be parallel to the electrode, not circumferential. Finish grind on a 120 grit wheel. Adjust the arc on clean scrap metal, with no scale.

Shielding gas flow should be 25 cubic feet per hour.

Table 20 – Typical GTAW Parameters, Direct Current Electrode Negative

Tungsten Electrode Diameter	Amperage	Volts
0.040 inch	60-80	9-11
0.062 inch	80-110	10-12
0.094 inch	130-160	16-18

Table 21 – Typical Chemistry GTAW weld deposit, Weight %

C	Si	Mn	Cr	Ni	N
0.07	1.6	0.7	21.0	10.0	0.15

Submerged Arc Welding (SAW)

RA 253 MA is sub-arc welded using the neutral basic AvestaFlux® 805 (Basicity index 1.7). This is an agglomerate type welding flux characterized by neat deposit surfaces, a smooth transition zone between the parent and weld metal, easy slag removal and excellent resistance to moisture absorption during storage. Flux consumption of between 0.5 to 0.8 pounds of flux per pound of wire is typical.

Correct joint geometry must be used to avoid hot cracking in sub-arc welding. This means that the width of the joint must be greater than the depth. The width to depth ratio should be between 2 and 3. Interpass temperatures should be kept below 200°F for the SAW process.

Table 22 – Typical SAW Parameters, Direct Current Reverse Polarity (DCRP)

Wire Diameter	Current Amps	Voltage Volts	Wire Stickout	Travel Speed inch/min
0.062 inch	225-300	29	0.75 inch	8-12
0.094 inch	300-400	29-33	1 inch	16-24
0.125 inch	400-450	29-33	1 inch	16-24

DISSIMILAR METAL WELDING

Table 23 – Suggested Fillers for Dissimilar Weld Joints

Base Metal 1	Base Metal 2	Filler Metal
RA 253 MA	Mild Steel	309
	304, 316, 309	RA 253 MA or 309
	310	RA 253 MA
	RA330, RA333, 800H, 600, 601	RA333
	RA 602 CA	RA 602 CA

FORMING

RA 253 MA may be formed, sheared, and machined. Alloying with nitrogen results in a high yield point (54,000 psi typical). For this reason, greater force is required and more spring-back may be anticipated than with 304 or 309 stainless. All traces of forming lubricants must be removed prior to welding, annealing, or use in high temperature service.

Forming at room temperature is suggested whenever possible. If hot bending is required, the workpiece should be heated uniformly throughout its section to 2000°F (1100°C), finishing above 1650°F (900°C). Overheating or excessive hold time at starting temperature should be avoided to minimize grain growth.

No forming or bending should be performed in the low ductility range of 1200-1600°F (650-870°C). Forming in this temperature range may cause intergranular tearing in austenitic alloys.

MACHINING

Heat resistant austenitic alloys are generally more difficult to machine than conventional austenitic stainless steels. Since RA 253 MA is alloyed with nitrogen and rare earth metals, both higher cutting forces and a more rapid tool wear should be expected.

Use the most stable machine tools available. Stainless steels generate high cutting forces and large loads on the tools and the set-up. The set-up of the tools and the work piece must be rigid. The work piece must be adequately supported to avoid deflections by the cutting forces. Extensions on tools should be kept as small as possible. Long tool extensions and/or unstable cutting conditions severely increase the risk of vibration and tool failure.

Always use tools with sharp cutting edges. It is important that the cutting edge is sharp but it must also be strong enough to withstand the cutting forces. Change the insert or regrind the tool at more frequent intervals than for carbon steels. A blunt cutting edge produces higher cutting forces and a thicker strain hardened layer than a sharp edge. This applies especially to high alloy stainless steels. For cemented carbide tools, it is important that the edge chamfer is small enough to give a cutting edge that is effectively “sharp”. Do not use a larger nose radius than necessary as this may cause vibrations.

Use a depth of cut that is deep enough to let the cutting edge work below the strain hardened layer created by previous passes or operations.

Use the correct cutting speed. Too slow of a cutting speed increases the risk of built-up edge formation, tool failure and may result in a poor surface finish of the machined surface.

When cutting fluid is used it should always be applied liberally to the cutting zone. If possible use cutting oils and emulsions with EP-additives.

The machining data given below represents general guidelines or starting values. These may need to be adjusted to the actual conditions of a specific machining operation. They are based on a tool life of approximately 15 minutes for cemented carbide tools and approximately 40 minutes for high-speed steel tools.

Table 24 – Turning, Longitudinal and Face Turning

	Cemented Carbide		High Speed Steels
	Roughing	Finishing	Finishing
Cutting Speed ft/min	295-395	395-525	46-59
Feed, inch/turn	0.012-0.024	0.002-0.012	0.02-0.008
Depth of cut, inches	0.08-0.20	0.02-0.08	0.2-0.08
Cemented Carbide Grade	C5, C6	C6, C7	-

Notes: Use coated cemented carbide inserts with positive chipbreaker styles. Use as small an entering angle as possible during roughing. Use cutting fluid. When roughing, SPUN and TPUN geometries may be used with good results. When face turning large workpieces use a tougher cemented carbide grade.

Table 25 – Drilling, Twist with High Speed Steels

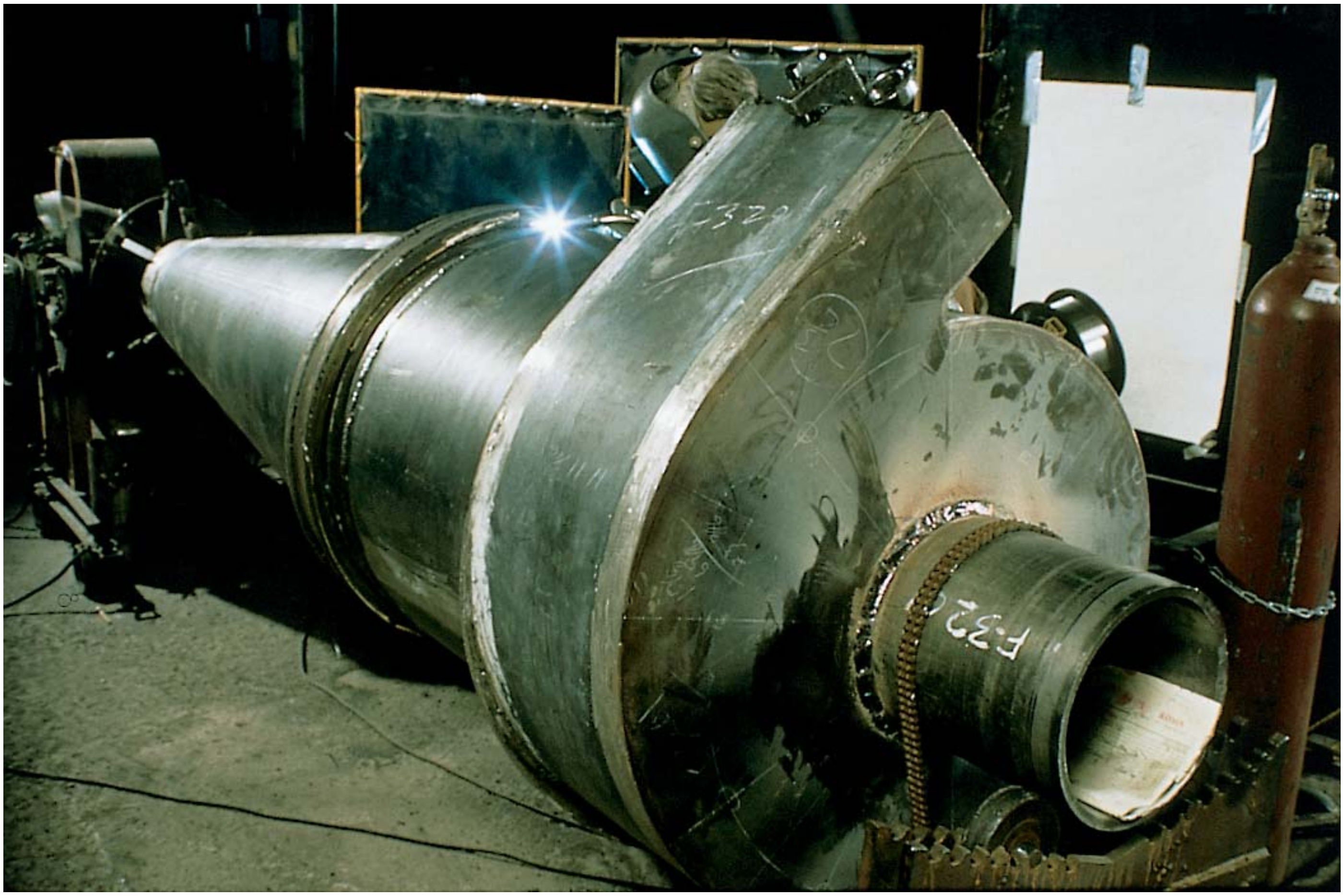
Drill Diameter inch	Cutting Speed feet/minute	Feed inch/rev
1/32, 1/8	16-26	0.0015
1/4	16-26	0.003
3/8	26-33	0.005
5/8	26-33	0.008
3/4	26-33	0.010
1-1/4	26-33	0.012
1-1/2	26-33	0.013

ANNEALING

Solution annealing of RA 253 MA is performed at 1920 to 2100°F (1050 to 1150°C) for 5 to 20 minutes, rapid air cool or water quench. Plate is most commonly annealed at about 1960 to 2000°F (1070 to 1100°C).

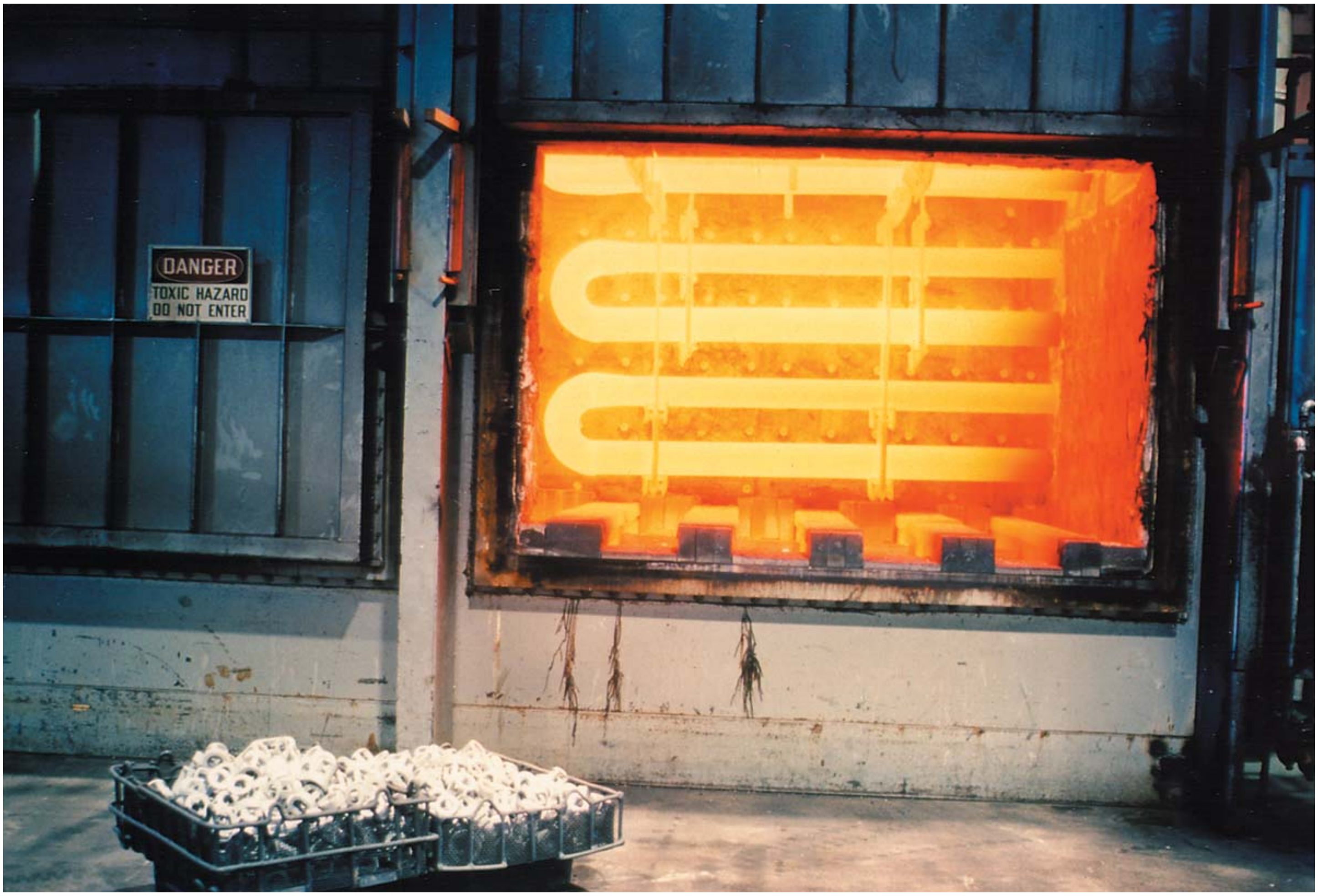
About 70% of residual stresses may be relieved by holding between 1560 to 1740°F (850 to 950°C) for about 15 minutes followed by an air cool.

After severe cold work (more than 10-20% cold work) it is desirable to solution anneal for maximum creep rupture strength. This is appropriate for service above 1450°F (800°C).



Coal fired power plant using a pressurized fluidized bed combustion (PFBC) boiler. RA 253 MA used for the cyclones (pictured), and gas collecting pipe for this project at American Electric Power (AEP) TIDD project in Brilliant, OH. Cyclones separate out particulate from the exhaust gases, which are fed into a gas turbine. Combustion temperatures were 1500-1600°F. RA 253 MA selected for its excellent strength and its resistance to wastage by the combined effects of oxidation, sulfidation and abrasion.

RA 253 MA boiler tube separators used at a Midwestern U.S. coal fired power plant, which replaced type 309 stainless. RA 253 MA was selected because of its improved strength, oxidation and sulfidation resistance compared to 309 stainless.



RA 253 MA radiant U-tubes mounted horizontally in a heat treat furnace. Typical operating temperature was 1800°F. Exothermic atmosphere used for annealing. Tubes were fabricated with a 6" OD x 11ga wall firing leg and a 5-1/8" OD x 11ga wall exhaust leg. Picture shown after 10 months in service. RA 253 MA replaced RA330.

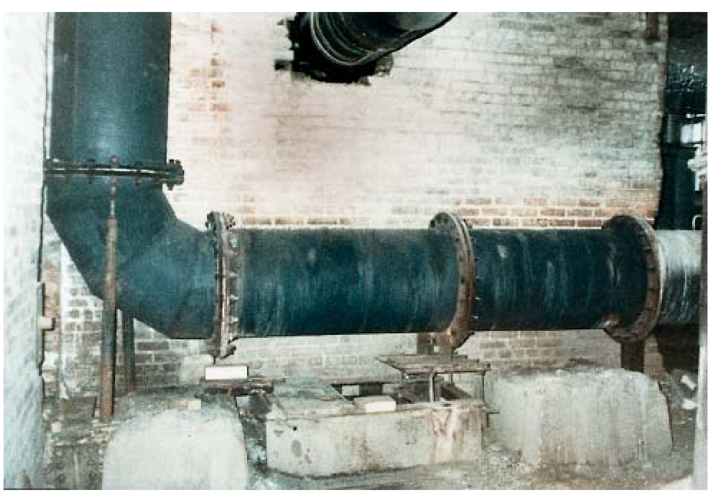
RA 253 MA pipe replaced type 310 stainless steel in this recuperator system off of a zinc galvanizing line. Estimated process temperatures were 1600°F (average) and 1750°F maximum. The recuperator used 2"SCH40 pipe. 310 and 316 stainless pipe used in the front three rows, the inlet for hot exhaust gases, of the recuperator failed from scaling in less than 1 year. RA 253 MA was installed and photos show its condition after 2 years in service. Latest inspection reported no RA 253 MA after four years of service.

Steel Processing & Heat Treating

¾" RA 253 MA pipe is being used at several steel mills for the injection of pulverized and/or granulated coal into the blast furnaces. Hot air blast temperatures can vary from 1650°F to 2200°F in temperature depending on the mill. RA 253 MA is used for its excellent resistance to oxidizing/sulfidizing conditions involved in coal combustion.

RA 253 MA material used for the hot sections of this recuperative thermal oxidizer for both the tubesheets and the shell.   of the unit.

RA 253 MA plate has been used to replace both cast HK and wrought 310H stainless hangers in crude heaters. RA 253 MA offers much greater stress-rupture values than 310H stainless approaching that of cast HK. Since RA 253 MA is a wrought alloy it provides greater toughness and soundness than a casting and as a result is less prone to sudden brittle failures.



24" OD hot air ducting at a U.S. pulp & paper mill. 316 stainless was used previously, which failed in one years time. Operating temperature estimated at 1940°F with some SO_2 in the air stream. RA 253 MA was in service for over three years.

DATA SHEET
RA 253 MA®
UNS S30815

Corporate Office

Rolled Alloys
125 West Sterns Rd
Temperance, Michigan 48182
1-800-521-0332
1-734-847-0561
fax: 1-734-847-6917
e-mail: sales@rolledalloys.com
www.RolledAlloys.com

North American Locations:

California, Connecticut, Illinois, Ohio, Oklahoma, Texas
Alberta, Ontario

Global Location:

China, France, Germany, The Netherlands, Scotland, Singapore, Spain, United Kingdom