Alleima® 7RE10

Tube and pipe, seamless

Datasheet

Alleima® 7RE10 is an austenitic, stainless chromium-nickel steel of the 25/20 type, suitable for high-temperature applications. The grade is characterized by:

- Good resistance to carburization, sulphidation, and oxidation combined with moderate creep strength and structural stability.
- A maximum service temperature in air of 1100°C (2010°F).

Standards

- ASTM: TP310S, TP310H
- UNS: S31008, S31009
- EN Number: 1.4845
- EN Name: X 8 CrNi 25-21
- W.Nr.: 1.4845
- DIN: X 12 CrNi 25 21
- SS: 2361
- AFNOR: Z 12 CN 25.20

Product standards

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Seamless tube and pipe

- ASTM A213, A312
- EN 10297-2
- Stahl-Eisen-Werkstoffblatt 470
- SS 14 23 61
- NFA 49-117

Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni
0.06	≤0.75	1.5	≤0.030	≤0.015	24.5	21

Applications

The good, general high temperature corrosion resistance of Alleima® 7RE10 makes it suitable for a wide range of applications:

- Furnace tubes
- Recuperators
- Muffle tubes in continuous wire annealing furnaces
- Thermocouple protection tubes
- Radiant tubes
- Tube hangers in petroleum and steam boilers
- Burners

Corrosion resistance

Alleima® 7RE10 has very good resistance to oxidation and sulphidation. It can be used in:

- Air up to 1100°C (2010°F)
- Sulphur-containing atmospheres up to 650-1050°C (1200-1920°F), depending on service conditions. Factors to consider are whether the atmosphere is oxidizing or reducing and whether impurities such as sodium and vanadium are present

The high chromium content of Alleima® 7RE10 makes the material resistant to oxidizing aqueous solutions. Alleima® 7RE10 also has better resistance to chloride induced stress corrosion cracking than lower alloyed steels of type ASTM 304 and 316.

Alleima® 7RE10 has good resistance in cyanide melts and neutral salts melts at high temperature. The material is insensitive to "green rot" attack.

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Bending

Annealing after cold bending is not normally necessary, but this should be reviewed depending on the degree of bending and the operating conditions.

Heat treatment, if any, should take the form of stress relieving or solution annealing. See under "Heat treatment". Solution annealing is recommended for tubes used at temperatures above 750°C (1380°F), and when the highest possible creep strength is required in the bent tube.

Hot bending is carried out at 1100-850°C (2010-1560°F) and should be followed by solution annealing.

Forms of supply

Seamless tube and pipe - finishes and dimensions

Seamless tube and pipe in Alleima® 7RE10 is supplied in dimensions up to 260 mm outside diameter, in the solution annealed and white-pickled condition or in the bright annealed condition.

Stock sizes

Alleima® 7RE10 is stocked in sizes ranging from 13.5 mm to 168.28 mm (6") outside diameter. Additional data concerning sizes and finishes is available on request from your nearest Alleima office.

Heat treatment

Tubes are generally delivered in the solution annealed condition. If another heat treatment is needed after further processing the following is recommended:

Stress relieving

850-950°C (1560-1740°F), 10-15 minutes, cooling in air.

The temperature should not be allowed to fall below 850°C (1560°F), because of the risk of sensitization.

Solution annealing

1000-1150°C (1830-2100°F), 5-20 minutes, rapid cooling in air or water.

Mechanical properties

At 20°C

Metric units

Proof strength		Tensile strength	Elong.		Hardness
$R_{p0.2}$ [1)]	$R_{p1.0}$ [1)]	R_m	A [2)]	$A_{2"}$	HRB

MPa	MPa	MPa	%	%	
≥220	≥250	530-750	≥35	≥35	≤90

At 68°F

Imperial units

Proof strength		Tensile strength	Elong.		Hardness
$R_{p0.2}$ [1)]	$R_{p1.0}$ [1)]	R_m	A [2)]	$A_{2"}$	HRB
ksi	ksi	ksi	%	%	
≥32	≥35	77-109	≥35	≥35	≤90

1 MPa = 1 N/mm^2
1) $R_{p0.2}$ and $R_{p1.0}$ correspond to 0.2% offset and 1.0% offset yield strength, respectively.
2) Based on $L_0 = 5.65 \sqrt{S_0}$ where L_0 is the original gauge length and S_0 the original cross-sectional area.

At high temperatures

Metric units

Temperature	Proof strength	
°C	$R_{p0.2}$	$R_{p1.0}$
	MPa	MPa
	min	min
50	213	238
100	192	217
150	176	201
200	161	186
250	150	175
300	141	166
350	134	159
400	129	154
450	125	150
500	123	148
550	121	146

Imperial units

Temperature	Proof strength

°F	$R_{p0.2}$	$R_{p1.0}$
	ksi	ksi
	min	min
200	28.3	31.9
300	25.6	28.9
400	23.2	26.8
500	21.4	25.1
600	20.1	23.8
700	19.1	22.8
800	18.4	22.0
900	17.9	21.6
1000	17.6	21.2

Creep strength

Creep rupture strength 10 000 h, average values

Metric units Imperial units

Temperature, °C	MPa	Temperature, °F	ksi
525	155	1000	20.9
550	133	1050	18.0
575	113	1100	14.6
600	96	1150	12.0
625	81	1200	9.9
650	68	1250	7.8
675	55	1300	6.2
700	44	1350	5.0
725	36	1400	4.1
750	30	1450	3.3
775	25	1500	2.8
800	21	1550	2.3
825	18	1600	1.8
850	15	1650	1.5
875	12	1700	1.1
900	10	1750	0.8

925	8
950	6

Values for creep strain 1% can be given on request.
Creep rupture strength 100 000 h, average values

Metric units Imperial units

Temperature, °C	MPa	Temperature, °F	ksi
525	105	1000	13.8
550	85	1050	10.7
575	68	1100	8.6
600	56	1150	6.7
625	45	1200	5.3
650	36	1250	4.1
675	29	1300	3.4
700	24	1350	2.8
725	20	1400	2.3
750	17	1450	1.8
775	14	1500	1.4
800	11	1550	1.1
825	9	1600	0.8
850	7	1650	0.6
875	5	1700	0.5
900	4	1750	0.4
925	4		
950	3		

Values for creep strain 1% can be given on request.

Physical properties

Density: 7.9 g/cm3, 0.29 lb/in3

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	13	68	7.5
100	15	200	8.5
200	17	400	10
300	19	600	11.5

400	21	800	12.5
500	23	100	13.5
600	25	1200	14.5
700	26	1300	15

Specific heat capacity

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
20	470	68	0.11
100	495	200	0.12
200	530	400	0.13
300	555	600	0.13
400	580	800	0.14
500	600	1000	0.15
600	615	1200	0.15
700	630	1300	0.15

Thermal expansion, mean values in temperature ranges ($x10^{-6}$)

Temperature, °C	Per °C	Temperature, °F	Per °F
20-100	15.0	68-200	8.5
20-200	15.5	68-400	8.5
20-300	16.0	68-600	9.0
20-400	16.5	68-800	9.5
20-500	17.0	68-1000	9.5
20-600	17.5	68-1200	9.5
20-700	18.0	68-1400	10.0
20-800	18.5	68-600	10.0
20-900	19.0	68-1800	10.5
20-1000	19.0		

Modulus of elasticity ($x10^{3}$)

Temperature, °C	MPa	Temperature, °F	ksi
20	195	68	28.3
100	190	200	27.6
200	182	400	26.4
300	174	600	25.1
400	166	800	23.8

500	158	1000	22.5

Structural stability

Like other austenitic stainless steels, Alleima® 7RE10 has better structural stability than high alloyed ferritic steels. At temperatures between 800 and 900°C (1470-1650°F), however, the structural stability will be slightly impaired. For service in this temperature range, we recommend the use of Sanicro® 31HT, which has better structural stability.

Welding

The weldability of Alleima® 7RE10 is good. Suitable methods of fusion welding are manual metal-arc welding (MMA/SMAW) and gas-shielded arc welding, with the TIG/GTAW method as first choice.

In common with all fully austenitic stainless steels, Alleima® 7RE10 has low thermal conductivity and high thermal expansion. Welding plans should therefore be carefully selected in advance, so that distortions of the welded joint are minimized. If residual stresses are a concern, solution annealing can be performed after welding.

Welding of fully austenitic stainless steel can entail the risk of hot cracking in the welded joints, particularly under high constraint.

For Alleima 7RE10, heat-input of <1.0 kJ/mm and interpass temperature of <100°C (210°F) are recommended. A string bead welding technique should be used.

Recommended filler metals

TIG/GTAW or MIG/GMAW welding

ISO 14343 S 25 20 / AWS A5.9 ER310 (e.g. Exaton 25.20.C)

MMA/SMAW welding

ISO 3581 E 25 20 B / AWS A5.4 E310-15 (e.g. Exaton 25.20.B)

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