ESSHETE 1250
TUBE AND PIPE, SEAMLESS

DATASHEET

Esshete 1250 is a fully austenitic chromium-nickel steel with excellent high- temperature strength and good resistance to corrosion in boiler applications. The grade can be used at temperatures up to about 650°C (1200°F), it is easily fabricated and also characterized by:

- High strength in relation to other typical candidate austenitic alloys
- Very good resistance to steam and flue gas atmospheres
- Good structural stability at high temperatures
- Good weldability

STANDARDS

- UNS: S21500
- EN Number: 1.4982
- EN Name: X10CrNiMoMnNbVB15-10-1

Product standards

- ASTM A213
- EN 10216-5

Approvals

- VdTÜV-Werkstoffblatt 520
- PED (Pressure Equipment Directive) 2014/68/EU

CHEMICAL COMPOSITION (NOMINAL)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo	V	Nb	B
0.1	0.5	6.3	≤0.035	≤0.015	15	9.5	1.0	0.3	1.0	0.005

APPLICATIONS

The high creep strength of Esshete 1250, combined with its good resistance to steam and flue gas atmospheres, makes it a very suitable material for use in coal-fired boilers. The grade was developed in the United Kingdom in the 1960's, and the bulk of the material has been used in the UK power industry in 500 and 660 MW boilers.

The main application has been superheaters and reheaters operating at 570°C (1058°F), steam pressure 170 bar (superheaters) and 40 bar (reheaters). Typical metal temperature 600–700°C (1112–1292°F), in flue gas temperature 900–1200°C (1652–2192°F). The corrosion environment on the fireside in the UK boilers was historically very aggressive as the British coal has, typically a high chlorine content of up to 0.6%, sulphur at 1–2% and a high ash content of 20%.

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Esshete 1250 has also been used successfully in superheaters in biomass boilers, burning various biofuels and producing steam at 580–540°C (1076–1004°F) at 60–200 bars pressure.

Trademark information: Esshete 1250 is a trademark owned by Corus

CORROSION RESISTANCE

Air

Good resistance to scaling up to 800°C (1472°F).

Gaseous corrosion

Good resistance to steam and flue gas atmospheres. In service conditions typical of coal-fired boilers, the alloy has a very similar fireside corrosion to alloys of the ASTM 316H type. However, the much increased high-temperature strength gives significantly improved service performance. Fireside corrosion resistance in coal-fired, biomass-fired or coal/biomass co-fired boilers is similar to that of type ASTM 347H. Steam-side corrosion is similar to that of type ASTM 347H.

BENDING

Esshete 1250 can be cold bent to narrow bending radii. Heat treatment after cold bending is not normally necessary, but this must be decided after considering the degree of bending and the operating conditions.

If post bending heat treatment is carried out, it should be in the form of solution annealing.

Hot bending is carried out at 1100–850°C (1832–1652°F) and should be followed by solution annealing.

FORMS OF SUPPLY

Seamless tube and pipe in Esshete 1250 is supplied in dimensions up to 260 mm (10.24 in.) outside diameter, in the solution annealed and white-pickled condition or in the bright annealed condition.

HEAT TREATMENT

Tubes are delivered in the heat treated 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.

Solution annealing

1050–1150°C (1920–2100°F), 5–20 minutes, rapid cooling in air, gas or water.

MECHANICAL PROPERTIES

Metric units, at 20°C

Proof strength		Tensile strength	Elongation		Hardness
$R_{p0.2}$[a)]	$R_{p1.0}$[a)]	R_m	A[b)]	A2"	HRB
MPa	MPa	MPa	%	%	
≥230	≥270	540–740	≥35	≥35	≤90

1 MPa = 1 N/mm^2

Imperial units**, at 68°F**

Proof strength		Tensile strength	Elongation		Hardness
$R_{p0.2}$[a)]	$R_{p1.0}$[a)]	R_m	A[b)]	A2"	HRB
ksi	ksi	ksi	%	%	
min.	min.		min.	min.	max.

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Imperial units**, at 68°F**

Proof strength		Tensile strength	Elongation		Hardness
$R_{p0.2}$ a)	$R_{p1.0}$ a)	R_m	A b)	$A_{2"}$	HRB
ksi	ksi	ksi	%	%	
min.	min.		min.	min.	max.
33	39	78–107	35	35	90

a) $R_{p0.2}$ and $R_{p1.0}$ correspond to 0.2% offset and 1.0% offset yield strengths, respectively.
b) 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	
	$R_{p.02}$	$R_{p1.0}$
°C	MPa	MPa
	min.	min.
50	213	254
100	188	232
150	171	210
200	161	195
250	153	190
300	148	187
350	145	184
400	144	182
450	141	179
500	139	178
550	136	175
600	133	170
650	130	165
700	125	159

Imperial units

Temperature	Proof strength	
	$R_{p.02}$	$R_{p1.0}$
°F	ksi	ksi
	min.	min.
100	31.2	37.4
200	27.9	33.7
300	25.1	30.8
400	23.1	28.6
500	21.7	27.1
600	21.0	26.4
700	20.8	26.2

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Imperial units

Temperature	Proof strength	
	$R_{p.02}$	$R_{p1.0}$
°F	ksi	ksi
	min.	min.
800	20.6	26.1
900	20.3	25.8
1000	19.8	25.4
1100	19.3	24.7
1200	18.7	23.9
1300	18.1	22.9

Creep strength

The creep rupture strength values correspond to values evaluated by Sterling tubes Ltd. The data from creep tests made by Sandvik correspond well to the given data.

Metric units

Temperature	Creep rupture strength, MPa		
°C	10 000 h	100 000 h	250 000h
600	241	199	177
610	231	185	158
620	221	167	134
630	210	147	109*
640	198	122	90*
650	184	100	78*
660	167	84	69*
670	147	74	52*
680	124	66	56*
690	102	59	51*
700	86	54	46*
710	75	49	42*
720	67	45	37*
730	61	40*	32*
740	55	36*	-
750	51	30*	-
760	46	-	-
770	42	-	-
780	38	-	-
790	34	-	-

* Values, which have involved extended stress/time extrapolation

Imperial units

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Temperature	Creep rupture strength, ksi		
°F	10 000 h	100 000 h	250 000 h
1100	35.2	30.7	28.8
1125	33.9	27.2	23.3
1150	32.0	23.5	18.5
1175	29.6	19.5	14.6*
1200	26.7	15.3	11.5*
1225	23.2	10.7	9.2*
1250	19.1	9.8	8.3*
1275	14.5	8.6	7.3*
1300	11.6	7.5	6.3*
1325	10.0	6.4	5.3*
1350	8.6	5.5	4.4*
1375	7.4	4.6	-
1400	6.5	3.9	-
1425	5.7	-	-
1450	5.1	-	-

* Values, which have involved extended stress/time extrapolation

PHYSICAL PROPERTIES

Density: 7.9 g/cm^3, 0.29 lb/in^3

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h°F
20	13	68	7
100	14	200	8
200	15	400	9
300	17	600	10
400	19	800	11
500	20	1000	12
600	22	1200	13
700	23	1400	13.5
800	24	1500	14

Specific heat capacity[1)]

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
20-100	505	68-200	0.12
20-200	530	68-400	0.13
20-300	540	68-600	0.13
20-400	545	68-800	0.13
20-500	555	68-1000	0.13
20-600	560	68-1200	0.13

Specific heat capacity[1)]

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
20-700	565	68-1400	0.14
20-800	575	68-1600	0.14
20-900	580	68-1800	0.14
20-1000	585	-	-

1) Mean values in temperature ranges

Thermal expansion[1)]

Temperature, °C	Per °C	Temperature, °F	Per °F
20-100	15	68-200	8.5
20-200	16	68-400	9
20-300	17	68-600	9.5
20-400	18	68-800	10
20-500	18.5	68-1000	10.5
20-600	19	68-1200	10.5
20-700	19	68-1400	11
20-800	19.5	68-1600	11
20-900	20	68-1800	11
20-1000	20	-	-

1) Mean values in temperature ranges ($x10^{-6}$)

Resistivity

Temperature, °C	μΩm	Temperature, °F	μΩin.
20	0.74	68	29.1
100	0.80	200	31.3
200	0.88	400	34.6
300	0.94	600	37.5
400	1.00	800	39.9
500	1.05	1000	41.8
600	1.09	1200	43.6
700	1.13	1400	45.1
800	1.16	1600	46.3
900	1.18	1800	47.2
1000	1.20	-	-

Modulus of elasticity[1)]

Temperature, °C	MPa	Temperature, °F	ksi
20	192	68	27.8
100	184	200	26.6
200	176	400	25.5
300	168	600	24.2

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Modulus of elasticity[1)]

Temperature, °C	MPa	Temperature, °F	ksi
400	160	800	22.9
500	151	1000	21.5
600	143	1200	20.2
700	135	1400	18.9
800	127	1600	17.7
900	120	-	-

1) (x10^3)

STRUCTURAL STABILITY

As in other austenitic stainless steels, sigma phase can be formed after long heat treatment in the range 550–950°C (1022–1742°F). Due to the low chromium content, Esshete 1250 is significantly less sensitive to sigma phase formation than steels of e.g. the ASTM 316 type, according to tests involving ageing for 100000 h.

WELDING

The weldability of Esshete 1250 is good. Welding must be carried out without preheating and subsequent heat treatment is normally not required. 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.

For Esshete 1250, heat input of <1.5 kJ/mm and interpass temperature of <150°C (300°F) are recommended.

Recommended filler metals

TIG/GTAW or MIG/GMAW welding

ISO 18274 S Ni 6082 / AWS A5.14 ERNiCr-3 (e.g. Exaton Ni72HP)

MMA/SMAW welding

ISO 14172 E Ni 6182/ AWS A5.11 ENiCrFe-3 (e.g. Exaton Ni71)