Alleima® 1C256
Tube and pipe, seamless
Datasheet

Alleima® 1C256 is a ferritic chromium steel for high-temperature applications. The grade is characterized by:

- Good resistance to reducing sulphurous gases
- Good resistance to oxidation in air

This steel can be used at temperatures up to 850°C (1560°F). However, allowance should be made for the low creep strength at the highest temperatures to avoid distortion due to the inherent mass of the steel.

Standards

- EN Number: 1.4724**
- W.Nr.: 1.4724*
- DIN: X10CrAl13*

Product standards

- SEW 470
- EN 10095**

* Obsolete. Replaced by EN.
** Heat resisting steels and nickel alloys. Technical delivery conditions for sheet/plate, strip, bars, rods and sections.

Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ti	Al
≤0.04	1.0	0.7	≤0.035	≤0.015	12.5	0.4	1.0

Applications

Alleima® 1C256 should be chosen mainly for service in slightly sulphidizing gases where low-alloy austenitic stainless steel may suffer corrosion. Typical applications for Alleima 1C256 are:

- Heat exchangers for high-temperature applications
- Thermocouple protection tubes

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– Injection nozzles

Corrosion resistance

Air
Alleima® 1C256 is highly resistant to oxidation, both at constant and at cyclically varying temperatures. The service temperature in air should not exceed about 850°C (1560°F).

Hot corrosion / sulphidation
Owing to its combined aluminium, silicon and chromium content and the absence of nickel, Alleima® 1C256 has a good resistance in sulphidizing gases.

Bending

Bending of tubes in Alleima® 1C256 can be carried out cold or hot. Annealing is not normally necessary after cold bending.

Hot-worked tubes should preferably be bent hot, but they can be bent cold, if the bending radii is greater than 5 times the diameter.

Hot bending is carried out at 900–800°C (1650–1470°F).

Forms of supply

Seamless tube and pipe in Alleima® 1C256 is supplied in dimensions up to 120 mm (4.72 in.) outside diameter in the annealed condition, but is also available white-pickled after annealing.

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

800–850°C (1470–1560°F), 10-30 minutes, rapid cooling in air.

Annealing

800–860°C (1470–1580°F), 5-60 minutes, rapid cooling in air.

Hotworking

1100–800°C (2010–1470°F).

Mechanical properties

Metric units, at 20°C

Proof strength	Tensile strength	Elongation	Hardness
$R_{p0.2}$ [1]	R_m	A [2]	
MPa	MPa	%	Vickers
			approx.
≥250	400 [3]–650	≥15	196

1 MPa = 1 N/mm^2

Imperial units, at 68°F

Proof strength	Tensile strength	Elongation	Hardness
$R_{p0.2}$[1)]	R_m	A[2)]	
ksi	ksi	%	Vickers
			approx.
≥36	58[3)]–94	≥15	196

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-section area.
3) Hot finished products do not generally fulfill the min R_m requirement (450 MPa, 65 ksi) according to SEW 470.

Creep strength (approx. values)

Metric units

Temperature	Creep rupture strength, MPa	
°C	10 000 h	100 000 h
500	100	55
600	35	20
700	9.5	5.0
800	4.3	2.3
900	1.9	1.0

Imperial units

Temperature	Creep rupture strength, ksi	
°F	10 000 h	100 000 h
930	14.5	8.0
1110	5.1	2.9
1290	1.38	0.73
1470	0.62	0.33
1650	0.28	0.15

Since Alleima 1C256 has very large creep-rupture elongation, often more than 100%, and little resistance to creep, it is necessary to allow for considerable creep deformation long before rupture occurs. At normal service temperatures, i.e. over 700°C (1290°F), even the mass of the tubes can cause stresses leading to extensive deformations.

Careful attention must, therefore, be given to the way in which the tubes are supported. Alleima 1C256, in common with other ferritic chromium steels, is less tough than austenitic stainless steels in the as-delivered condition.

Physical properties

Density: 7.7 g/cm^3, 0.28 lb/in^3

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	21	68	12.5
500	23	200	13

Specific heat capacity

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
20	500	68	0.12

Thermal expansion[1)]

Temperature, °C	Per °C	Temperature, °F	Per °F
20–200	10.5	68–400	6
20–400	11.5	68–800	6.5
20–600	12	68–1200	7
20–800	12.5	68–1600	7
20–1000	13.5	68–1800	7.5

1) mean values in temperature ranges x10^{-6}

Modulus of elasticity[1)]

Temperature, °C	MPa	Temperature, °F	ksi
20	195	68	28.5
200	190	400	27.5
400	180	800	25.5
600	145	1200	20.5
800	125	1400	18.5
1000	120	1800	17.5

1) x 10^3

Resistivity

Temperature, °C	µΩm	Temperature, °F	µΩin.
20	0.75	68	29.5

Structural stability

The structural stability of Alleima® 1C256 is good, because of the low chromium content. Grain growth may be experienced at service temperatures above 900°C (1650°F).

Welding

The weldability of Alleima® 1C256 is good. Welding must be carried out with preheating at 200-300°C (390-570°F), subsequent heat treatment is normally required for matching filler metals. 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 Alleima® 1C256, heat-input of <1.5 kJ/mm and interpass temperature of <150°C (300°F) are recommended.

Recommended filler metals

TIG/GTAW welding

- ISO 14343 S 29 9 / AWS A5.9 ER312 (e.g. Exaton 29.9) or
- ISO 14343 S 25 20 / AWS A5.9 ER310 (e.g. Exaton 25.20.C) or
- ISO 18274 S Ni 6082 / AWS A5.14 ERNiCr-3 (e.g. Exaton Ni72HP)

MMA/SMAW welding

- ISO 3581 E 29 9 R / AWS A5.4 E312-16 (e.g. Exaton 29.9.R) or
- ISO 3581 E 25 20 B / AWS A5.4 E310-16 (e.g. Exaton 25.20.B) or
- ISO 14172 E Ni 6182/ AWS A5.11 ENiCrFe-3 (e.g. Exaton Ni71)

When using the austenitic stainless-steel wire electrode S 25 20/ER310 and the covered electrode E 25 20 B/ E310-16, the higher thermal expansion of the austenitic weld metal must be considered.

When using nickel alloy wire electrode S Ni 6082/ERNiCr-3 and covered electrode E Ni 6182/ENiCrFe-3, a lower corrosion resistance of the weld metal in a reducing sulphurous environment than the Alleima® 1C256 must be considered.

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