Austenitic Stainless Steel

Aperam 301 17-7A / 17-7C / 17-7E

Chemical Composition

Grades	C	Si	Mn	Cr	Ni	Mo
17-7A	0.11	0.90	1.20	16.80	6.55	—
17-7C	0.10	0.60	0.85	17.30	7.25	—
17-7E	0.10	1.15	1.20	16.65	6.65	0.70

Typical values (%)

European designation	American designation
Type 1.4310 [1] with a lower carbon content (better for stamping and corrosion resistance)	Type 301 [2][3] with a higher Cr content (better for corrosion resistance)
[1] Assimilated to EN10088-2 X10CrNi18-8	[2] Assimilated to ASTM A240 [3] Our grade 17-7E is not compliant with 301 designation

This grade complies with:

- Aperam Stainless Europe - Safety Information Sheet for Stainless Steel
- European Directive 2000/53/EC on end-of-life vehicles and later modifications
- Standard NFA 36 711 "Stainless Steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption (non packaging steel)"
- Requirements of NSF/ANSI 51 edition international standard for "Food Equipment Materials" and with F.D.A. (United States Food and Drug Administration) requirements regarding materials used for food contact
- European Parliament and of the Council regulation N° 1935/2004 of the of 27 October 2004, on materials and articles intended to come into contact with food (and repealing Directives 80/590/EEC and 9/109/EEC)
- French regulatory paper dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs

Key Features

- High mechanical properties that can easily be enhanced by work hardening (temper rolling)
- Very good corrosion resistance in atmospheric, urban and freshwater conditions
- Limited corrosion resistance at elevated temperatures (400-800°C) due to high carbon content (risk of intergranular corrosion)

17-7A	standard grade, cost-effective solution
17-7C	ideal for projects where slightly lower mechanical properties are needed
17-7E	well-suited for applications requiring bending properties and fatigue resistance

Applications

- Springs (for T < 300°C)
- Building industry (hand tools, security shoe soles, etc.)
- Automotive parts: cylinder head gaskets, connectors, braking system parts, etc.
- Sink drainers
- Catering equipment
- Conveyor belts
- Railway rolling stock
- Lorry structures
- Hubcaps
- Medical and safety equipment

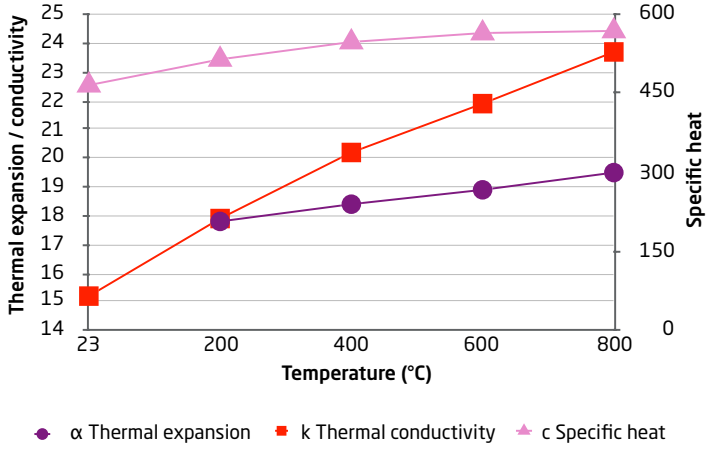
Product Range

	Precision Strip	Precision Sheet	Coils & Sheets		
			17-7A		17-7C and 17-7E
Thickness (mm)	0.06 up to 2.5	0.20 up to 2.5	2.5 up to 14 (1D) 0.4 up to 2 (2R) 0.4 up to 8 (2B)	4.5 up to 14 (1D) 0.8 up to 2 (2R) 1 up to 8 (2B)	2.5 up to 14 (1D) 0.4 up to 2 (2R) 0.4 up to 8 (2B)
Width (mm)	3 up to 700	40 up to 670	up to 1,250	up to 1,500	up to 1,250
Finish	2R / 2B / 2D / 2H	2R / 2B / 2D / 2H	1D / 2R / 2B	1D / 2R / 2B	1D / 2R / 2B

Physical Properties

Cold rolled and annealed sheet

Density	d	kg/dm³	23°C	7.9
Melting temperature	-	°C	Liquidus	1,449
Specific heat	c	J/kg.K	23°C	466
Thermal conductivity	k	W/m.K	23°C	15.2
Thermal diffusivity	D	10^{-6} m²/s	23°C	4.13
Mean coefficient of thermal expansion	α	10^{-6}/K	20-200°C 20-400°C 20-600°C 20-800°C	17.8 18.4 18.9 19.5



Mechanical Properties

Annealed condition

In accordance with ISO 6892-1, part 1
Test sample perpendicular to rolling condition

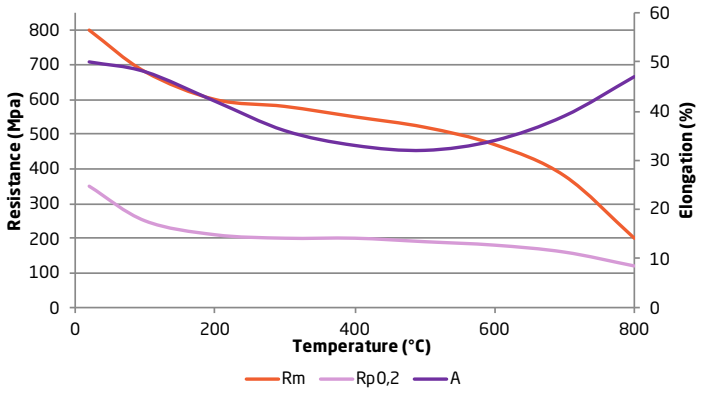
Test piece

Length = 50 mm
Typical values on 0.4 mm

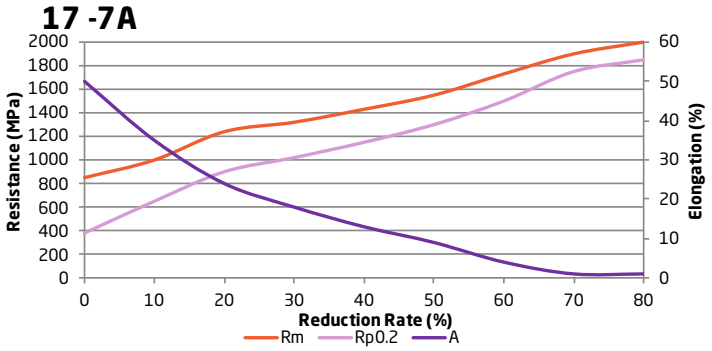
Grade	European designation	Condition	Rm (1) (MPa)	$Rp_{0,2}$ (2) (MPa)	A (3) %	Hardness (HV)
304	1.4301	Cold-rolled	650	300	54	170
17-7A	1.4310	Cold-rolled	850	380	48	195
17-7C	1.4310	Cold-rolled	750	330	50	180
17-7E	1.4310	Cold-rolled	830	370	48	195

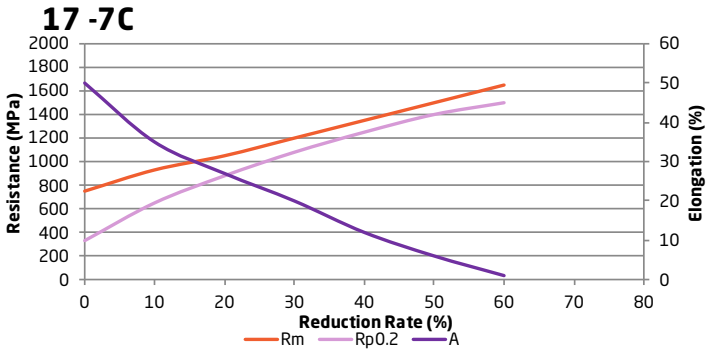
1MPa = 1N/mm²
(1) Ultimate Tensile Strength (UTS)
(2) Yield Strength (YS)
(3) Elongation (A)

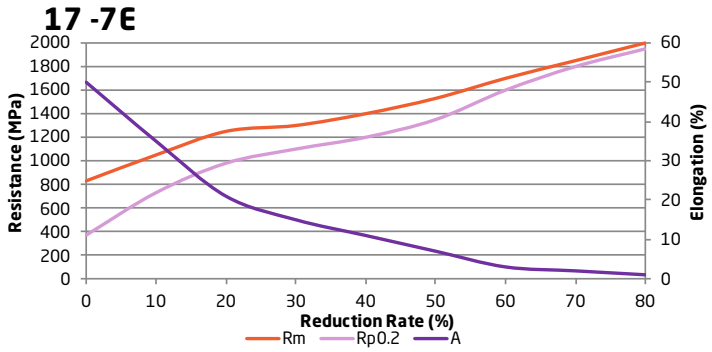
At high temperatures



Mechanical properties as a function of degree of work-hardening at ambient temperature







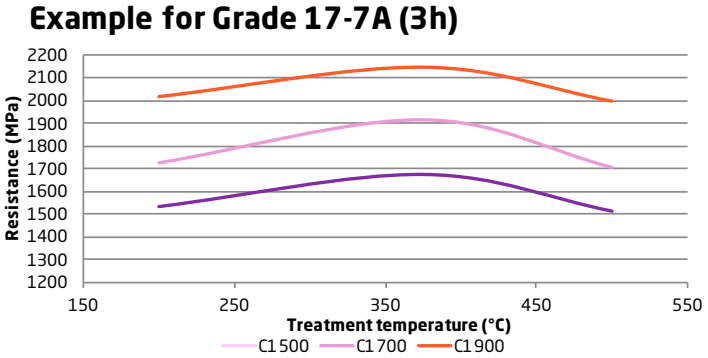
Mechanical properties in the work-hardened condition

Strain hardening (temper class)	17-7A			17-7E			17-7C		
	Rm (MPa)	$Rp_{0.2}$ (MPa)	A (%)	Rm (MPa)	$Rp_{0.2}$ (MPa)	A (%)	Rm (MPa)	$Rp_{0.2}$ (MPa)	A (%)
C850	850	380	50	850	390	48	850	600	40
	1,000	650	35	1,000	650	37	1,000	700	30
C1000	1,000	650	35	1,000	650	37	1,000	700	30
	1,150	800	26	1,150	850	26	1,150	950	20
C1150	1,150	800	26	1,150	850	26	1,150	950	20
	1,300	1,050	16	1,300	1,050	16	1,300	1,120	14
C1300	1,300	1,050	16	1,300	1,050	16	1,300	1,120	14
	1,500	1,300	6	1,500	1,300	8	1,500	1,350	4
C1500	1,500	1,300	6	1,500	1,300	8	1,500	1,350	4
	1,700	1,500	3	1,700	1,450	2	1,700	1,500	1
C1700	1,700	1,500	3	1,700	1,450	2	—	—	—
	1,900	1,750	1	1,900	1,750	1	—	—	—
C1900	≥ 1,900	≥ 1,750	≤ 1	≥ 1,900	≥ 1,750	≤ 1	—	—	—

The elevated mechanical properties of our 17-7A, 17-7C and 17-7E grades, which are obtained through work hardening, give these three grades with excellent fatigue resistance.

Indicative typical values. For more information, please contact us.

Secondary hardening capability



In addition to their high work hardenability, our 17-7A and 17-7E grades exhibit a "bake-hardening" or secondary hardening effect that can be obtained using post-forming heat treatment on the components. This hardening effect is directly related to the degree of prior cold forming.

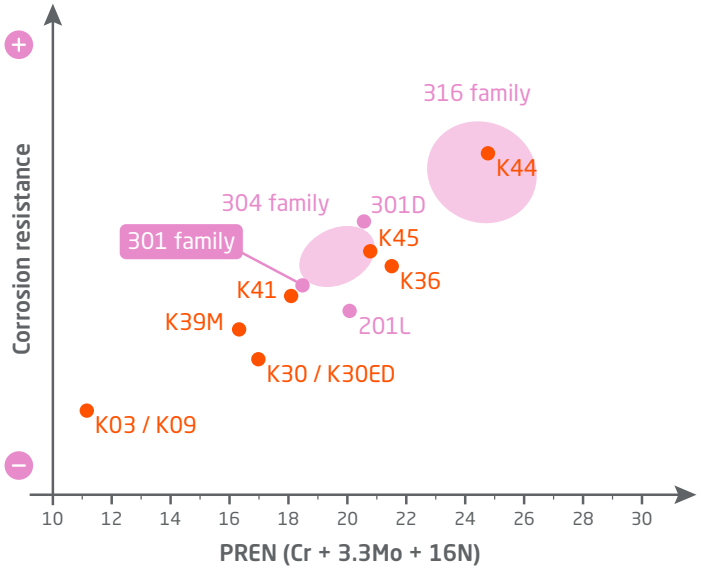
Influence of temperature on strain-hardened conditions

When our 17-7A, 17-7C and 17-7E grades are exposed to temperatures below 0°C, a slight increase in Rm and $Rp_{0.2}$ is observed, accompanied by a reduction in A%. Conversly, exposure to high temperatures brings about a rapid reduction in Rm and $Rp_{0.2}$, accompanied by an appreciable increase in A%.

Corrosion Resistance

Our 17-7A, 17-7C and 17-7E grades are slightly less resistant than our 304 type 1.4301 alloy. They are well-suited to freshwater, urban atmospheres and foodstuffs. It should be noted that these three grades are highly susceptible to the intergranular corrosion caused by precipitation of chromium carbides when exposed to temperatures in the range 400-800°C.

Pitting potential in various temperatures and chloride concentrations



Forming

17-7A, 17-7C and 17-7E grades, in the strain-hardened (tempered) condition, respond well to common cold forming operations (bending, profiling, curving, drawing, metal spinning, etc.). As a result, they are also well-suited to ironing, but their drawability is less than that of our 304 type 1.4301 grade.
Cold work-hardening absorbs considerable power on the forming tools.

Component designs must compensate for springback, which increases with the use of higher classes of strain hardening.

Welding

Our 17-7A, 17-7C and 17-7E grades are weldable in thin gauges using either resistance spot or seam welding. Please contact us about all other processes, particularly in the case of heavy gauges and/or strain-hardened condition. This is because welding operations can significantly reduce mechanical properties in the heat affected zones, leading to risks of intergranular corrosion.

Welding process	No filler material	With filler metal			Shielding gas
	Typical thicknesses	Thicknesses	Filler material		Hydrogen and nitrogen forbidden in all cases
			Rod	Wire	
Resistance: spot, seam	< 2 mm				
TIG	< 1.5 mm	> 0.5 mm	ER 308L [(1)] ER 347L [(1)(2)]	ER 308L [(1)] ER 347L [(1)(2)]	Ar Ar + 5% H_2 Ar + He
PLASMA	< 1.5 mm	> 0.5 mm		ER 308L [(1)] ER 347L [(1)(2)]	Ar Ar + 5% H_2 Ar + He
MIG		> 0.8 mm		ER 308L [(1)] ER 347L [(1)(2)]	Ar + 2% CO_2 Ar + 2% O_2 Ar + 2% CO_2 + 1% H_2 Ar + He
SAW		> 2 mm		ER 308L [(1)]	
Electrode		Repairs	ER 308L [(1)] ER 347L [(1)(2)]		
Laser	< 5 mm				He Under certain circumstances: Ar N

[(1)] AWS A5.9 - [(2)] EN ISO 14343 - [(3)] EN 439

No heat treatment is necessary after welding. In order to fully restore the corrosion resistance of the metal, the welds must be mechanically or chemically descaled and then passivated and decontaminated.

However, depending on the application, this operation may be not essential.
If there is a risk of intergranular corrosion, a solution annealing treatment at 1,075°C ±25°C must be carried out.

Heat Treatment and Finishing

Annealing

After cold forming (work hardening) and welding (risk of intergranular corrosion in the weld joint), using an annealing treatment for a couple of minutes at 1,075 ±25°C, followed by water quenching or air cooling, restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses. After annealing, pickling, followed by passivation, are necessary.

Pickling

- Nitric-Hydrofluoric acid mixture (10% HNO_3 + 2% HF) at ambient temperature or up to 60°C
- Sulfuric-nitric acid mixture (10% H_2SO_4 + 0.5% HNO_3) at 60°C
- Use descaling pastes for weld areas

Passivation

- 20-25% HNO_3 solution (36° Baumé) at 20°C
- Use passivating pastes for weld zones

Polishing

The surfaces of our 17-7A, 17-7C and 17-7E grades are suitable for all kinds of polishing (grit scotch-brite, electro polishing).