UGINOX
F12T

Titanium stabilized extra mild
12 % chromium ferritic stainless steel

European designation[1]
X2CrTi12
1.4512

American designation[2]
AISI 409

(1) According to NF EN 10088-2
(2) According to ASTM A 240

This grade is in accordance with:
- UGINE & ALZ Material Safety Data Sheet n°1: stainless steels (European Directive 2001/58/EC).
- European Commission Directive 2000/53/EC for end-of-life vehicles, and to Annex II dated 27 June 2002.

Chemical composition
Mean values

Elements	C	Si	Mn	Cr	Ti
%	0.01	0.5	0.30	11.5	0.180

General characteristics

The principal features of **UGINOX F12T** are:
- good weldability
- good formability similar to that of low alloy steels
- good oxidation resistance up to 800°C
- good corrosion resistance in natural atmospheres and in contact with moderately aggressive media.

Typical applications

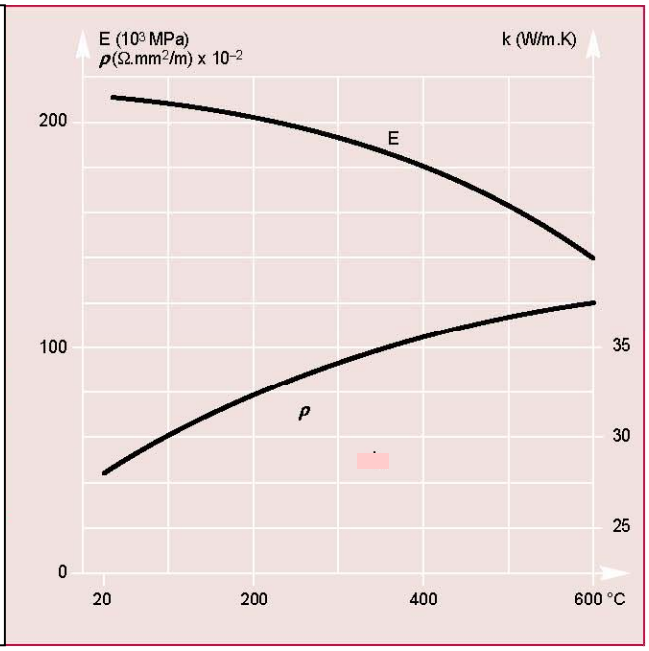
- Various parts of automotive exhaust systems: manifolds, front pipes, catalyst shells, mufflers.
- Welded structures exposed to relatively unaggressive corrosion conditions or subjected to temperatures not exceeding 800°C.

Product range

Forms: sheets, blanks, coils, strips, circles
Thicknesses: 0.4 to 6,5 mm
Width: according to thickness, consult us
Finish: cold rolled or hot rolled, depending on the thickness

Physical properties (cold rolled sheet - annealed)

Density	d	–	4 °C	7.7
Melting temperature		°C		1460
Specific heat	c	J/kg.K	20 °C	460
Thermal conductivity	k	W/m.K	20 °C 500 °C	25 28.7
Mean coefficient of Thermal expansion	α	10^{-6}/K	20 - 200 °C 20 - 400 °C 20 - 600 °C 20 - 800 °C	11.0 12.0 12.1 12.8
Electric resistivity	ρ	Ω.mm²/m	20 °C	0.60
Magnetic permeability	μ	at 0.8 kA/m DC or AC	20 °C	850
Young's modulus	E	MPa.10^3	Rolling direction at 20 °C	220



Tensile properties

Annealed condition
According to NF EN 10002-1 (July 2001),
specimen perpendicular to the rolling direction

Specimen
Lo = 80 mm (thickness < 3 mm)
Lo = 5,65 √ So (thickness ≥ 3 mm)

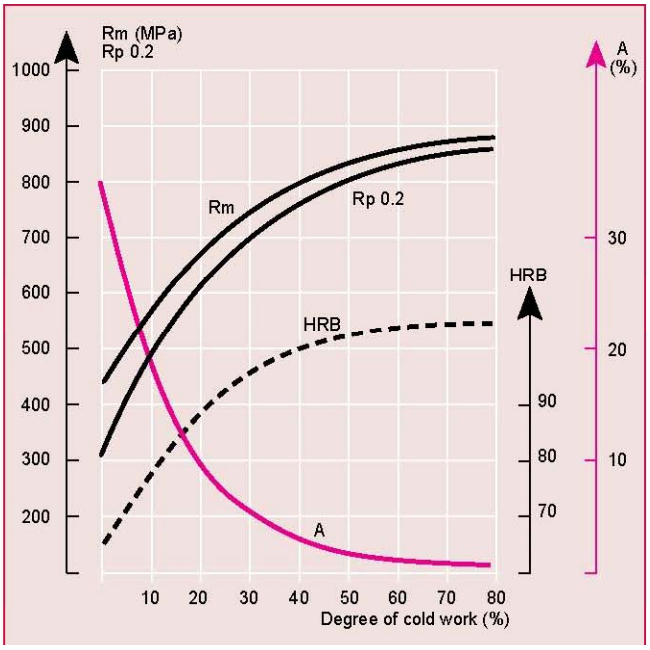
1 MPa = 1 N/mm²

	R_m (1) (MPa)	$Rp_{0,2}$ (2) (MPa)	A (3) (%)	HV
Cold rolled*	410	250	32	125

*Mean values (1) Ultimate Tensile Strength (UTS) (2) Yield Strength (YS) (3) Elongation (A)

At high temperature

Effect of cold work



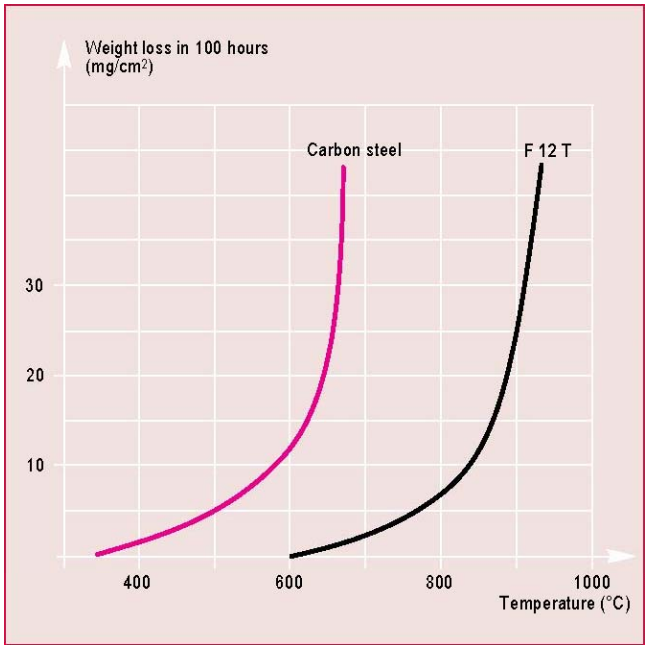
* Typical values

Corrosion resistance

Like all ferritic stainless steels:
- **UGINOX F12T** is insensitive to stress corrosion cracking
- **UGINOX F12T** resists corrosion by acid condensates in gasoline or diesel engine exhaust systems in the automobile manufacturer's simulation tests.

The corrosion resistance of welds and heat affected zones is similar to that of the base metal.

High temperature oxidation



Forming

UGINOX F12T can be readily cold formed by standard processes (folding, bending, drawing, etc.). Strain ratio = 1.2.

Erichsen test
(expansion)

Grade	European designation	AISI	Erichsen deflection* (1.5 mm thick sheet)
UGINOX F12T	1.4512	409	11.6

Welded tube bending
The bending ratios permissible with **UGINOX F12T** are given in the table below, based on laboratory results for a bending angle of 90°, where D is the tube diameter and R is the bending radius.

Bending (résultats en laboratoire)	Ra = R/D mini
40 mm Ø x 1.5 mm tube	1,1
50 mm Ø x 1.5 mm tube	1,1

Welding

UGINOX F12T can be resistance welded by spot or seam techniques. Good results are obtained without the need for post treatment provided that forging of the weld is sufficient.

Welding process	No filler metal	With filler metal			Shielding gas*
	Typical thicknesses	Thickness	Filler metal		*Hydrogen and nitrogen forbidden in all cases
			Rod	Wire	
Resistance Spot Seam	 ≤ 2 mm ≤ 2 mm				
TIG	< 1.5 mm	> 0.5 mm	W.N° 1.4370 ER 308 L (Si)	ER 308 L (Si) 430LNb	Argon Argon + Helium
PLASMA	< 1.5 mm	> 0.5 mm		ER 308 L (Si) 430LNb	Argon Argon + Helium
MIG		> 0.8 mm		ER 308 L Si 430LNb	Argon + 2% CO_2 Argon + 2% O_2 Argon + 2% CO_2 + Helium
S.A.W		> 2 mm		ER 308 L	
Electrode		Repairs	E 308 L		
Laser	< 5 mm				Helium Argon in certain conditions

The addition of hydrogen or nitrogen to the argon must be avoided since these gases decrease the ductility of the welds. For the same reason, nitrogen shielding must not be employed, while additions of CO2 must be limited to 3 %.

In order to restrict grain growth in the HAZ, the use of high welding powers must be avoided. For example, in automatic TIG welding, the power should not exceed 2.5 kJ/cm for a sheet thickness of 1.5 mm. Pulsed MIG/MAG welding has a lower power input than conventional MIG welding and enables better control of both bead geometry and grain size.

UGINOX F12T has a excellent medium and high frequency induction weldability.
Post-weld heat treatment is generally not necessary.
The welds must be mechanically or chemically descaled, then passivated.
Oxyacetylene torch welding is to be proscribed.

Heat treatment and finishing

Annealing
At 850°C followed by air cooling.
It is important never to exceed 925°C.
Parts must be thoroughly degreased prior to any heat treatment operation.

Head office:
UGINE & ALZ
5 rue Luigi CHERUBINI
F - 93210 LA PLAINE SAINT-DENIS CEDEX
www.ugine-alz.com

Sales information:
Tel: (33) 1 71 92 00 00
Technical information:
Tel: (33) 1 71 92 06 52
Fax: (33) 1 71 92 07 97

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