

# UGINOX

## F18TNb

### Titanium and niobium stabilized 18 % chromium ferritic stainless steel

European designation <sup>(1)</sup>
X2CrTiNb18
1.4509
American designation <sup>(2)</sup>
UNS 43932

(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.
- NFA 36 711 Standard «Stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption» (non packaging steel).

#### Chemical composition

Mean values

Elements	C	Si	Mn	Cr	Ti + Nb
%	0.02	0.5	0.5	17.8	0.7

#### General characteristics

The principal features of **UGINOX F18TNb** are:

- good weldability
- good formability
- good mechanical properties at high temperature, with no risk of sigma phase formation at intermediate temperatures
- good oxidation resistance up to 950°C
- good resistance to corrosion in automotive exhaust gases
- thermal conductivity higher than that of austenitic grades, with lower thermal expansion coefficient.

#### Typical applications

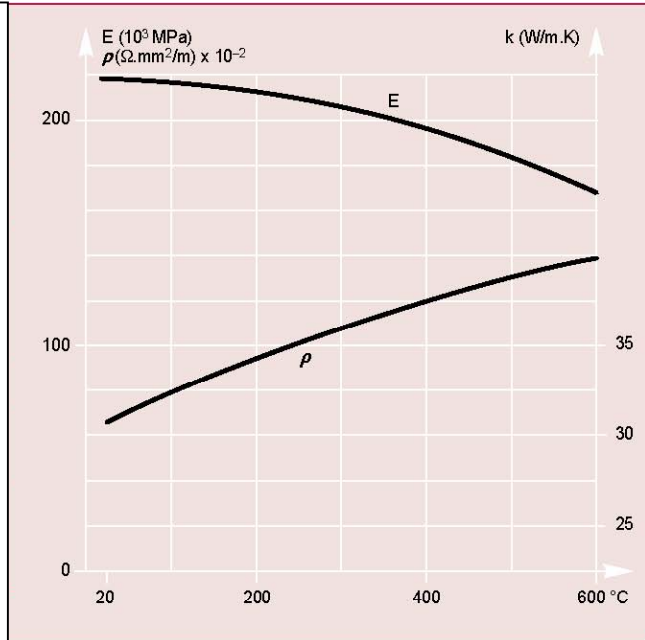
- Various exhaust system components (manifolds, front pipes, mufflers and catalytic converter shells), when UGINOX F12T is insufficient.
- Welded structures exposed to only moderately corrosive atmospheres or subjected to temperatures up to 950°C.
- Domestic fuel burners.
- Condensation boilers.

#### Product range

Forms: sheets, blanks, coils, strips, circles  
Thicknesses: 0.4 to 2 mm (consult us for thicknesses between 2 and 6.5 mm)  
Width: according to thickness, consult us  
Finish: cold rolled or hot rolled, according to the thickness

## Physical properties (cold rolled sheet - annealed)

Density	d	–	4 °C	7.7
Melting temperature		°C	Liquidus	1505
Specific heat	c	J/kg.K	20 °C	460
Thermal conductivity	k	W/m.K	20 °C 500 °C	25 26.3
Mean coefficient of Thermal expansion	$\alpha$	$10^{-6} /K$	20 - 200 °C 20 - 400 °C 20 - 600 °C 20 - 800 °C	11.0 11.5 12.1 12.8
Electric resistivity	$\rho$	$\Omega \cdot \text{mm}^2 / \text{m}$	20 °C	0.60
Magnetic permeability	$\mu$	at 0.8 kA/m DC ou AC	20 °C	850
Young's modulus	E	$\text{MPa} \cdot 10^3$	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

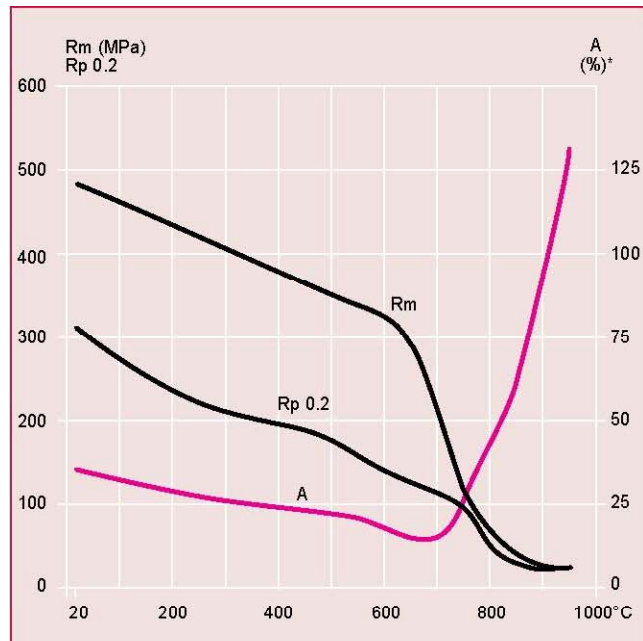
Lo = 80 mm (thickness < 3 mm)  
Lo = 5,65 √ So (thickness ≥ 3 mm)

1 MPa = 1 N/mm<sup>2</sup>

	R <sub>m</sub> <sup>(1)</sup> (MPa)	Rp <sub>0.2</sub> <sup>(2)</sup> (MPa)	A <sup>(3)</sup> (%)	HRB (100 kg)
Cold rolled*	490	300	30	75

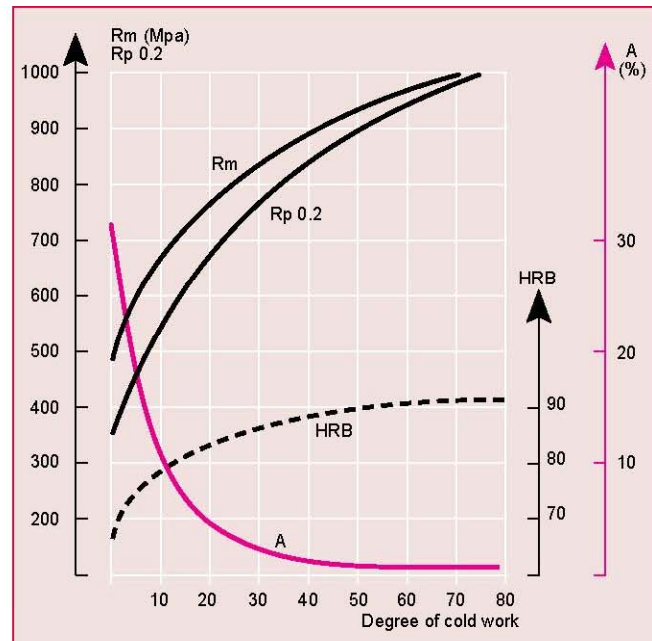
\* Mean values (1) Ultimate Tensile Strength (UTS) (2) Yield Strength (YS) (3) Elongation (A)

### At high temperature



\* Typical values

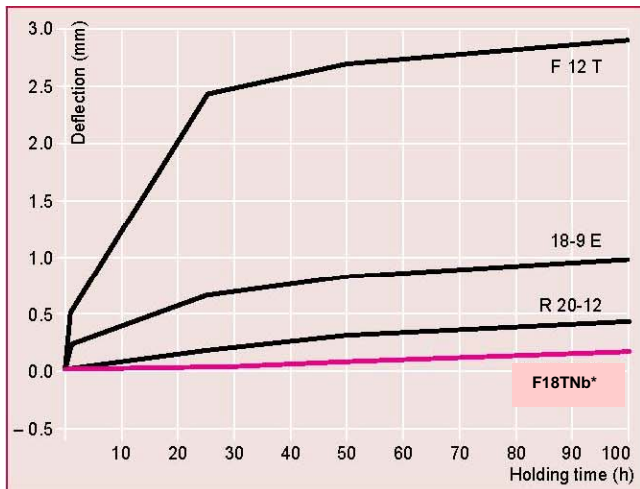
### Effect of cold work



## Creep properties

Sag-Test at 850°C

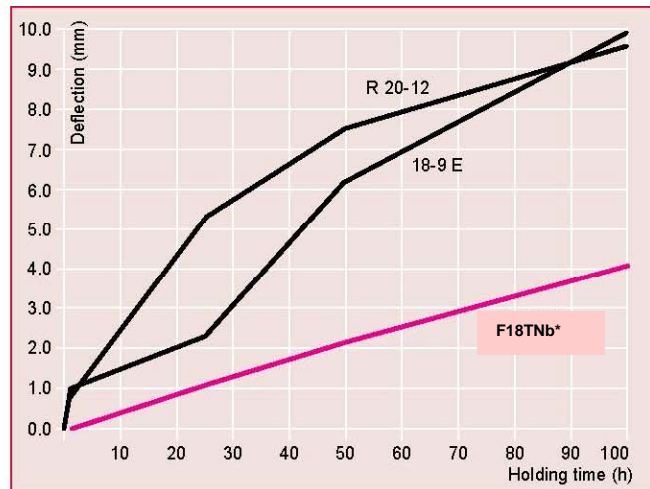
Thickness = 2mm



\* UGINE & ALZ analysis and processing

Sag-Test at 950°C

Thickness = 2mm



\* UGINE & ALZ analysis and processing

## Corrosion and oxydation resistance

Like all ferritic stainless steels :

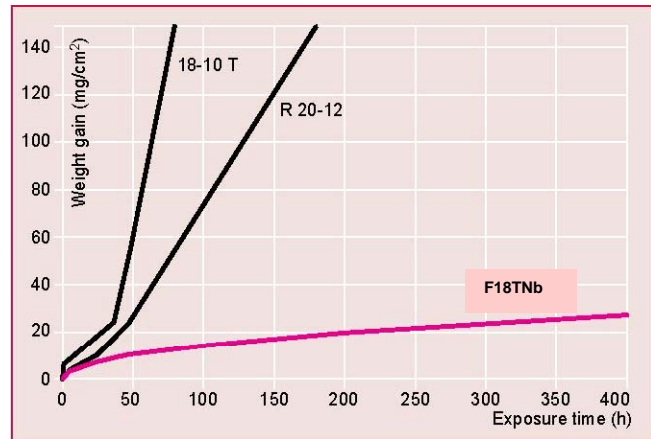
- **UGINOX F18TNb** is insensitive to stress corrosion cracking,
- **UGINOX F18TNb** has good resistance to acid condensates in gasoline and diesel engine exhaust systems, in the automobile manufacturers' simulation tests.

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

### Cyclique oxydation

Cyclic oxidation rates in air at 950°C (weight gains calculated from weight loss measurements after scale removal) for the UGINOX grades 18-10T, F 17TNb and R20-12.

**UGINOX F18TNb** has excellent resistance to oxidation at high temperatures, particularly under temperature cycling conditions, and can be used up to 980°C.



### Resistance to corrosion in condensates

UGINOX & ALZ grades	European material N°	AISI (UNS)	Cyclic« DIP-DRY » simulation tests in synthetic condensate - furnace at 300°C						
			Maximum depth of corrosion (in % on 0.5mm)						
			Free sheet surface		Crevice corrosion		Under-deposit corrosion		
			500 h	1000 h	30 j	90 j	30 j	30 j	5 j
UGINOX F12T	1.4512	409	1.2	3.6	36	100	3.6	21.6	100
UGINOX F17T	1.4510	430 Ti	1.2	2.4	7.2	70	2.5	19.2	54
<b>UGINOX F18TNb</b>	1.4509	(S43932)			3.6	8,5			

## Welding

**UGINOX F18TNb** 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	ER 308 L (Si) 430LNb	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 <sub>2</sub> Argon + 2% O <sub>2</sub> Argon + 2% CO <sub>2</sub> + 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 CO<sub>2</sub> 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 F18TNb** has an 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 and decontaminated. Oxyacetylene torch welding is to be proscribed.

## Forming

**UGINOX F18TNb** can be readily cold formed by standard processes (folding, bending, drawing, etc.).

### Welded tube bending

The bending ratios permissible with **UGINOX F18TNb** 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	Ra = R/D min.
50 mm Ø x 1.5 mm tube	1.2

Erichsen test (expansion)

Grade	European designation	UNS	Erichsen deflection (2 mm thick sheet)
UGINOX F18TNb	1.4509	S43932	11.8

## Heat treatment and finishing

### Annealing

At 960°C followed by air cooling. It is important to avoid exceeding 1000°C. Parts must be thoroughly degreased prior to any heat treatment operation.

### Pickling

Nitric-hydrofluoric acid mixture (10% HNO<sub>3</sub> + 2% HF) Descaling pastes for weld zones.

### Passivation

20-25 % HNO<sub>3</sub> solution at 20 °C  
Passivating pastes for weld zones.

### 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