TUBACEX
TX 28
Technical Data Sheet

Introduction

TX-28 is a highly alloyed austenitic stainless steel for extremely corrosive media application. It shows an excellent performance in the most aggressive enviroments of Oil Country Tubular Goods.

General Characteristics

TX-28 is a nickel-iron-chromium alloy with additions of molybdenum and copper. It is characterised by its high resistance to general corrosion in different environments. The resistance to stress corrosion cracking is excellent. The pitting and crevice corrosion resistance is excellent too. It shows a good weldability.

A. Technical Specifications

- ISO 13680
- API 5CRA
- ISO 15156/NACE MR0175

B. Chemical Composition

Typical values are (in percentage of mass):

C	Mn	Si	P	S	Cr	Ni	Mo	Cu	PREN
< 0.02	< 2.0	0.30	< 0.030	< 0.002	27.0	31.5	3.5	0.90	> 41

This composition guarantees PREN > 41, as per following formula: PRE = %Cr + 3.3 x %Mo + 16 x %N

C. Production Process

C.1. Steel Making Mill
Electric furnace process and Argon Oxygen Decarburization process (AOD) to refine the steel composition.

C.2. Pipe Production
The pipe production consists in a first hot working stage followed by a final cold working stage.

C.3. Heat Treatment
Depending on the final product requirements a heat treatment prior to the cold work could be applied. Minimum heat treatment temperature is 1080 ºC (1976 ºF) followed by a rapid cooling.

D. Mechanical Properties (Cold Worked Condition)

Different yield strenght grades are available. The most typical ones are 110 and 125 ksi.

At 20 °C	Grade 110	Grade 125
$Ys_{0,2\%}$ (ksi)	110 - 140	125 - 150
Ts (ksi)	> 120	> 135
A (%)	> 11	> 10
HRC	< 33	< 37
Impact test (*)	Av>50J / Ind>40J	

1 ksi = 6,895 MPa - 1 MPa = 0,145 ksi
(*) At -10 °C, transverse

Temperature yield derating factor at a given temperature:

Temperature °C (°F)	Yield Derating Factor
100 (212)	0,94
200 (392)	0,88

E. Physical Properties

E.1. Thermal Expansion Coefficient:

Mean coefficient between 20 °C and a given temperature:

Temperature °C (°F)	Coefficient (10^{-6} K^{-1})
100 (212)	15
200 (392)	15.5

E.2. Modulus of Elasticity

At 20 °C: 190 kN/ mm². At a given temperature:

Temperature °C (°F)	kN/ mm²
100 (212)	180
200 (392)	175

E.3. Poisson ratio

At 20 °C: 0,31. At a given temperature:

Temperature °C (°F)	V
100 (212)	0,31
200 (392)	0,32

E.4. Other Physical Properties:

- Density at 20 °C: 7.98 g/cm³
- Thermal conductivity at 20 °C: 10 W/K·m
- Electrical resistance at 20 °C: 0.80 Ω·mm²/m
- Specific heat capacity at 20 °C: 450 J/kg °C

F. Corrosion Properties

F.1. Intergranular Corrosion

TX-28 passes testing to ASTM A262 Practice E, ISO 3651-2 Method A and G28A without objections.

F.2. Stress Corrosion Cracking

F.2.1. Slow strain rate test (SSRT) method for screening CRAs for SCC in sour oilfield service (NACE TM0198)

Condition	Grade	Strain rate s-1	Cl^- (ppm)	pH	T °C (°F)	P H_2S kPa (psi)	P CO_2 kPa (psi)
1	125	4,00 10-6	280000	3,5	107 (225)	400 (58)	1200 (174)
2	125	4,00 10-6	150000	3,5	120 (248)	572 (83)	1138 (165)
3	110	4,00 10-6	280000	5,0	149 (300)	2068 (300)	1241 (180)
4	140	4,00 10-6	151500	3,0	149 (300)	2248 (326)	6895 (1000)

F.2.2. Resistance to SSC, SCC and GHSC in H2S environment (NACE TM0136 4PB)

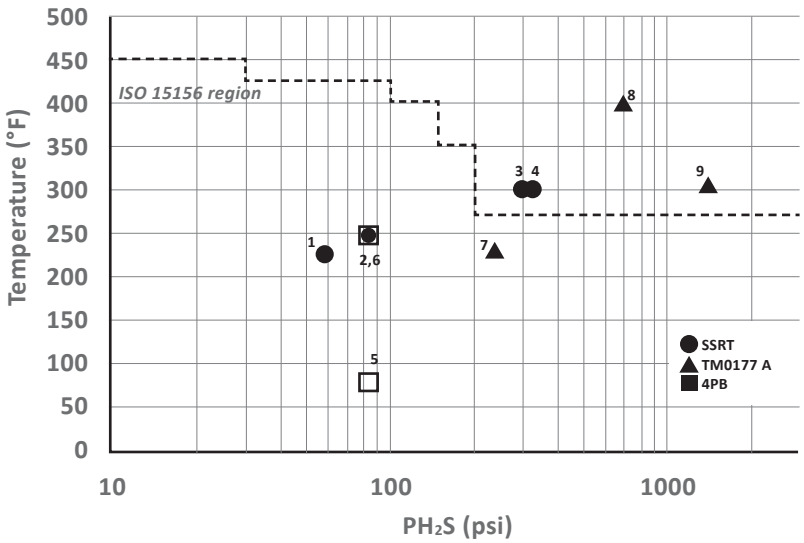
Condition	Grade	Cl^- (ppm)	Applied Sress	pH	T (°F)	P H_2S (psi)	P CO_2 (psi)
5	125	150000	100% AYS	3,5	75	83	165
6	125	150000	100% AYS	3,5	248	83	165

F.2.3. Resistance to SCC in H2S environment (NACE TM0177 method A)

Condition	Grade	Cl^- (ppm)	Applied Sress	pH	T (°F)	P H_2S (psi)	P CO_2 (psi)
7	110	30000	90% SMYS	2,7	230	239	123
8	125	130000	90% AYS	3,0	401	700	500
9	110	220000	90% SMYS	3,0	306	1400	560

F.2.4 Resistance to SCC in H2S environment (comparison with ISO 15156)

TX-28 grade 110 passes without objections the tests carried out within the ISO 15156 limits for this grade and even at more aggressive conditions:



F.3. Pitting and Crevice Corrosion Resistance

According to ASTM G48, TX 28 has a critical pitting temperature higher than 45°C and a critical crevice temperature higher than 20°C.