TUBACEX
TX G3
Technical Data Sheet

Introduction

TX-G3 is a nickel-iron-chromium alloy with additions of molybdenum and copper . It is used extensively as OCTG for critical well conditions combining high concentration of Chlorides, H2S and CO2. Nickel provides the alloy with exceptional stress-corrosion-cracking resistance in chloride-containing environments. The high molybdenum provides very good resistance to pitting and crevice corrosion. The low carbon helps prevent sensitization, giving the alloy resistance to intergranular corrosion.

General Characteristics

TX-G3 is a austenitic nickel-iron-chromium alloy with additions of molybdenum and copper. It is used in exploration for oil and gas with a wide range of highly corrosive environments providing an excellent combination of mechanical properties and strength.

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	W	Cr	Fe	Mo	Cu	Co	Nb+Ta
< 0.015	< 1.00	< 1.0	< 0.04	< 0.002	< 1.5	22.5	19.0	7.0	2	< 5.0	< 0.5

This composition guarantees PREN > 40, 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.

D. Mechanical Properties (Cold Worked Condition)

Different yield strength 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)	0,95
200 (392)	0,90

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

E.2. Modulus of Elasticity

At 20 °C: 200 kN/ mm². At a given temperature:

Temperature °C (°F)	kN/ mm²
100 (212)	195
200 (392)	190

E.3. Poisson ratio

At 20 °C: 0,42. At a given temperature:

Temperature °C (°F)	V
100 (212)	0,42
200 (392)	0,40

E.4. Other Physical Properties:

- Density at 20 °C: 8,12 g/cm³
- Thermal conductivity at 20 °C: 10 W/K·m
- Electrical resistance at 20 °C: 1,12 Ω·mm²/m
- Specific heat capacity at 20 °C: 450 J/kg ºC

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)

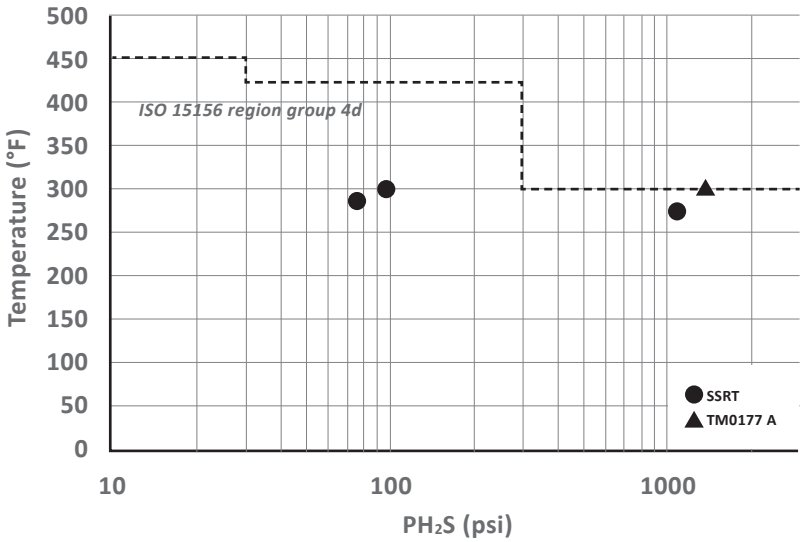
Condition	Grade	Test	Strain rate s-1	Cl^- (ppm)	pH	T °C (°F)	P H_2S kPa (psi)	P CO_2 kPa (psi)
1	110	NACE TM0198 SSRT	4,00 10-6	185000	5,0	140 (284)	538 (78)	1103 (160)
2	110	NACE TM0198 SSRT	4,00 10-6	151500	2,0	149 (300)	690 (100)	-
3	110	NACE TM0198 SSRT	4,00 10-6	180000	3,5	135 (275)	7584 (1100)	4137 (600)

F.2.2. Resistance to SCC in H2S environment (NACE TM0177 method A)

Condition	Grade	Test	Cl^- (ppm)	Applied Sress	pH	T °C (°F)	P H_2S kPa (psi)	P CO_2 kPa (psi)
4	110	NACE TM0177 METHOD A	220000	90% SMYS (*)	3,0	152 (306)	9653 (1400)	3861 (560)

F.2.3. Resistance to SCC in H2S environment (comparison with ISO 15156)

TX-G3 grade 110 passes without objections the tests carried out within the ISO 15156 limits for this grade:



F.3. Pitting and Crevice Corrosion Resistance

According to ASTM G48, TXG3 has a critical pitting temperature of 65°C and a critical crevice corrosion temperature of 40°C.