

Introduction

TX-25NP is a super-duplex stainless steel that has been specifically designed to work in the most aggressive environments of Oil Country Tubular Goods. The optimized austenitic-ferritic matrix allows to obtain an improved mechanical behavior combined with an excellent resistance to corrosion in corrosive environments with presence of H₂S, CO₂ and Chlorides.

General Characteristics

TX-25NP is an austeno-ferritic with a PREN higher than 40 and a phase balance close to 50%/50%. The mechanical behavior fulfils with the most exigent requirements.

A. Technical Specifications

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

B. Chemical Composition

UNS number: S32750.

Typical values are (in percentage of mass):

C	Mn	Si	P	S	Cr	Ni	Mo	N	PREN
<0.02	<1.2	<0.80	<0.030	<0.015	25.5	7	3.5	0.24 to 0.32	>40

This composition guarantees PREN > 40, as per following formula: $PRE = \%Cr + 3.3 \times \%Mo + 16 \times \%N$

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. The solution annealed grade is delivered with an additional final heat treatment.

C.3 Heat Treatment

Depending on the final product requirements a heat treatment prior to or after the cold work may be applied. Minimum heat treatment temperature is 1070 °C (1960 °F) followed by a very rapid cooling to avoid the presence of any third phase in the microstructure.

D. Mechanical Properties (Cold Worked Condition)

Different yield strength grades are available

		125ksi	80ksi
Rp0.2 (ksi)	MPa	862-1000	552-724
	Ksi	125-145	80-105
Rm (ksi)	MPa	>897	>758
	Ksi	>130	>110
A	%	>10	>20
HRC mean		<36	<28

1 ksi = 6,895 MPa - 1 MPa = 0,145 ksi

Temperature yield derating factor at a given temperature*:

Temperature °C (°F)	Yield Derating Factor
100 (212)	0.89
200 (392)	0.87

* For 125 ksi products

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)	13.5
200 (392)	13.8

E.2. Modulus of Elasticity

At 20 °C: 196 kN/ mm². At a given temperature*:

Temperature °C (°F)	kN/ mm ²
100 (212)	192
200 (392)	186

* For 125 ksi products

E.3. Poisson Ratio

At 20 °C: 0.36. At a given temperature*:

Temperature °C (°F)	ν
100 (212)	0.36
200 (392)	0.38

* For 125 ksi products

E.4. Other Physical Properties:

- Density at 20 °C: 7.79 g/cm³
- Thermal conductivity at 20 °C: 12 W/K·m
- Electrical resistance at 20 °C: 0.85 Ω·mm²/m
- Specific heat capacity at 20 °C: 410 J/kg °C

F. Corrosion Properties

F.1. Intergranular Corrosion

TX-25NP passes testing to ASTM A262 Practice E, ISO 3651-2 Method A 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 ₂ S kPa (psi)	P CO ₂ kPa (psi)
1	125	4 10 ⁻⁶	21000	3,1	80 (176)	8 (1,16)	
2	125	4 10 ⁻⁶	176000	5,5	190 (374)	10 (1,45)	4000 (580)
3	125	4 10 ⁻⁶	185000	5,5	232 (450)	10 (1,45)	4000 (580)
4	125	4 10 ⁻⁶	8170	3,5	24 (75)	100 (14,7)	760 (110)
5	125	4 10 ⁻⁶	30000	3,5	80 (176)	8,3 (1,2)	8274 (1200)

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

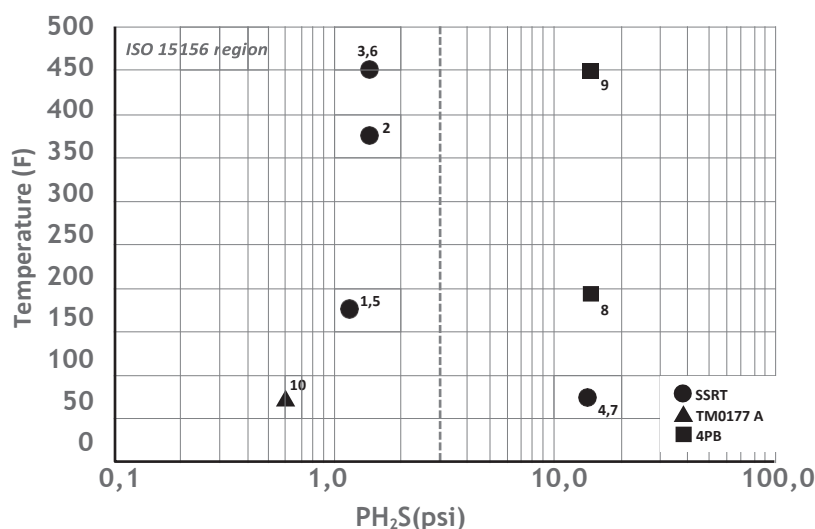
Condition	Grade	Actual Yield Strength_ksi	Applied Stress	Cl ⁻ (ppm)	pH	T °C (°F)	P H ₂ S kPa (psi)	P CO ₂ kPa (psi)
6	125	135	100% AYS	185000	5,5	232 (450)	10 (1,45)	4000 (580)
7	125	135	100% AYS	30350	3,5	24 (75)	100 (14,70)	760 (110)
8	125	135	100% AYS	30350	3,5	90 (194)	100 (14,70)	760 (110)
9	125	135	100% AYS	30350	3,5	232 (450)	100 (14,70)	760 (110)

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

Condition	Grade	Actual Yield Strength_ksi	Applied Stress	Cl ⁻ (ppm)	pH	T °C (°F)	P H ₂ S kPa (psi)
10	125	130	80% SMYS	21000	3,3	24 (75)	4 (0,60)

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

TX-25NP grade 125 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, TX-25NP has a critical pitting temperature of 60°C and a critical crevice temperature of 40°C.