



TUBACEX Stainless Steels for Nitric Acid Plants

TUBACEX, the leading global producers of stainless steels, has been supplying their quality stainless steel products 1.4335 MOD for numerous nitric acid plants.

Find below more information about materials typically applied in the Nitric Acid industry and the TUBACEX special grades for these applications.

TUBACEX is an industrial group founded in 1963 dedicated to the manufacture of seamless tubes of stainless steel and high nickel alloys and super-alloys. With its headquarters in Llodio (Alava, Spain), TUBACEX Group is a multinational leader in its sector with industry facilities in Spain, Austria, Italy, India and the United States, as well as a network of sales offices throughout the world. Assuring you the highest quality and full service at your door.

Stainless steels are the most used materials in Nitric Acid production.

Cr-Ni stainless steels are at a passive state up to some 67% nitric acid and, in this range of environments, basically different grades of austenitic grades are applied (mainly depending on concentration or temperature).

If temperature goes even higher, Alloy28 can be a good solution as well. Its high PREN number also helps in case Stress Corrosion Cracking (SCC) is an issue.

When SCC occurs, duplex materials can be considered, offering additional higher mechanical properties.

Above 90% nitric acid concentrations stainless steels start to be at a trans-passive state, so active corrosion with higher corrosion rates starts. Therefore, Silicon needs to be added to the chemical composition of the stainless steel.

TUBACEX offers a wide variety grades suitable for all possible environments: Refer to the enclosure.

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Nitric Acid
selection of
materials

Selection of materials for Nitric Acid Production

- **Austenitic Stainless Steels:**

- ✓ 304L, 1.4306, UNS30403. Base material with "limited" corrosion behavior.

1.4306 ✓ should be preferred above 1.4307 ✗, since its corrosion resistance is lower (**δ-ferrite** appears to be the cause, very detrimental).

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TXC01

Steel grade		C max	Si	Mn	P max	S max	N	Cr	Cu	Mo	Nb	Ni
Steel name	Steel number											
X2CrNi18-9	1.4307	0,030	≤ 1,00	≤ 2,00	0,040	0,015 ^b	≤ 0,10	17,5 to 19,5	-	-	-	8,0 to 10,0 ^c
X2CrNi19-11	1.4306	0,030	≤ 1,00	≤ 2,00	0,040	0,015 ^b	≤ 0,10	18,0 to 20,0	-	-	-	10,0 to 12,0 ^d
X5CrNi18-10	1.4308	0,030	≤ 1,00	≤ 2,00	0,040	0,015 ^b	≤ 0,10	18,0 to 20,0	-	-	-	10,0 to 13,0 ^d
X5CrNi18-9	1.4301	0,030	≤ 1,00	≤ 2,00	0,040	0,015 ^b	≤ 0,10	18,0 to 20,0	-	-	-	8,0 to 10,0 ^d

Higher Ni content (austenite stabilizer) makes the material less prone to **δ-ferrite** formation.

Source: DIN EN 10216-5:2014-03

Selection of materials for Nitric Acid Production

■ Austenitic Stainless Steels:

- ✓ 304L NAG, 1.4306S, UNS30403. "Clean" 304L with limited residual elements such as $C < 0,02$, $P < 0,01$ & $S < 0,01$, giving better Corrosion resistance to the material.

*1.4306S has restricted composition and $Mo < 0,01$.
Molybdenum is detrimental in nitric acid environments*

- ✓ 310L NAG, 1.4335, UNS31002. Upgraded grade for nitric acid resistance with even lower C, P & S.

1.4335 is much less sensitive to carbide precipitation and intergranular attack than 304L.

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TXC10

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TXT19

Selection of materials for Nitric Acid Production

■ Austenitic Stainless Steels:

- ✓ **1.4361, UNS30600.** High Si content grade for high nitric acid concentration production.

More than 2% Silicon content improves resistance to intergranular attack in strong nitric acid.

With high levels of silicon a thick silica layer is formed in addition to typical Chromium oxide.

- ✓ **Alloy28, 1.4563, N08028.** This Cr-Ni alloy, 27% Cr, 31%Ni, 2% Mo & 1,5%Cu gives good nitric acid resistant properties.

Alloy28 is specially resistant in hot nitric acid and additionally a good SCC resistance due to high PREN nr.

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TUBACEX
TXK15

Selection of materials for Nitric Acid Production

■ Duplex Stainless Steels:

When SCC is an issue, Duplex materials' mechanical properties can help:

- ✓ 1.4362, UNS32304. Low Molybdenum Duplex.
- ✓ 1.4462, UNS32205.
- ✓ UNS32906. Improved resistance to Chlorides.

Ferrite in Duplex steels can become σ -phase if exposed to temperatures in the sensitizing range. σ -phase is highly corroded by nitric acid.

To be taken into account when welding or performing weld repairs.

