Tech Note 1:
Chlorides, Chlorine & Stainless Steel

TN.01

Stainless steel has a high resistance but as with all materials, is not resistant to everything and may be prone to pitting or damage from the interaction with *chlorides or chlorine* in certain conditions. These conditions are dependent on the grade of stainless, temperature, concentration and exposure.

Chloride (Cl-) is a salt ion, a compound of Chlorine (Cl) and present in many chemicals and processes such as Sodium chloride (NaCl). **Chloride and Chlorine are different.**

Laboratory testing of project water samples is the only method to accurately confirm concentrations and is recommended when the likelihood of increased risk is possible. Bore water, saltwater and chemicals (including dosing and cleaning) are common sources that can be overlooked.

Design Considerations

Laboratory and metallurgist advice is highly recommended for installations due to the possible complexities for successful long term management. One or all of the following can affect the performance and requires careful review:

- Grade - Each grade of stainless has a different resistance. Eg 2205 has a higher resistance to chlorides than 316; 316 has a higher resistance to chlorides than 304.
- Temperature – higher the temperature, the lower the resistance to chlorides.
- Concentration – the higher the concentration, the lower the resistance to chlorides.
- Exposure – the greater contact time (eg stagnant water), the lower the resistance.
- Solution pH – Acidity and alkalinity effect the resistance (pH 7 = neutral).

Water Sample Testing

Testing several samples of the actual project water by a NATA accredited laboratory before installation is highly recommended as other chemicals in the water can alter values. Refer to our Tech Note TN.28 Water Sample Testing document for procedures and a range of tests recommended for different water types.

External Resistance

Stainless can be unknowingly exposed to chlorides from the external environment and insulation lagging effecting the outer surface of the material. Preventative measures include:

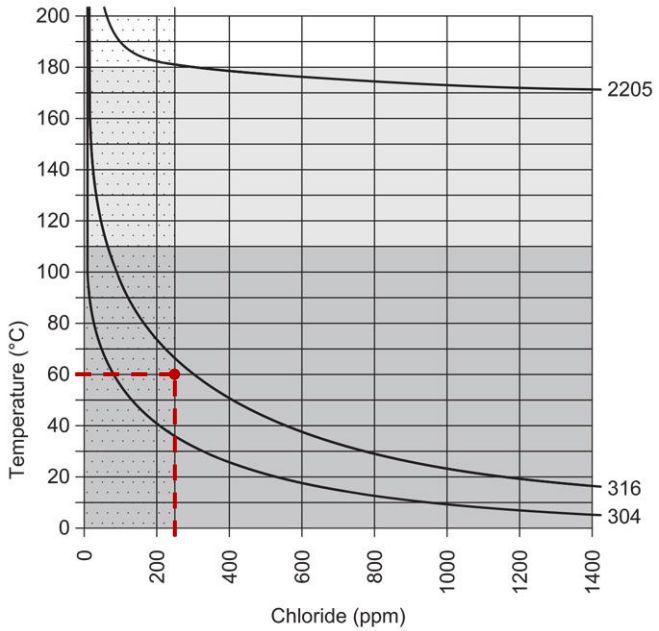
- Specify 'low chloride' insulation products or separate by wrapping (protecting) the stainless first with a barrier (eg petroleum-based tape wrap or plastic film) – see Tech Note TN.04 Insulation & Stainless regarding insulation & stainless steel for specifics.
- For coastal and industrial locations, include a wash and rinse process as part of a regular maintenance programme where salts exposure is present for external surfaces – see Tech Note TN.11 Marine Spray Environments & Stainless.
- High water table and soil chloride levels are recommended to be tested by a NATA certified laboratory– contact us if these conditions are present before installation.
- For reactive soil situations, lining the trench with geotextile fabric, then a bed and pipe cover of pH neutral sand (min pipe surround of 100mm), geotextile top cover to encase the sand then backfill can offer additional protection from the existing soil. Note press-fit is not recommended to be buried bare – refer Tech Note TN.07 Underground & Stainless.
- Cleaning agents, such as sanitisers, shall have their suitability with stainless steel confirmed before application including rinsing requirements – see Tech Note TN.29 Cleaning & Maintaining Stainless.

© 2023 AusPress Systems Pty Ltd. This document is intended as a guide only and specific assessment must be made for each project for suitability. No responsibility is taken for any errors or omissions, contained or implied in this document. Document may be updated or corrected at anytime without notice.

Concentrations – Chlorides and Chlorine

Resistance to Chlorides (Cl-)

Concentration Limits:
Maximum suitable levels of *chlorides* are charted for 304, 316 and 2205 grade stainless steels below in water, pH 7 (guide only).



Example (in red on chart):
At temperature 60°C and a Chloride concentration of 250ppm, grade 316 stainless is considered as resistant, but grade 304 is not.

Notes:

- Resistance to *Chlorides* reduces as the temperature increases.
- Potable Water: *Chlorides* 250ppm (max) Australian Drinking Water Guidelines (ADWG) 2011.
- Seawater: *Chlorides* ~30,000ppm, but depends on location.
- Ring seal temperature limits must be considered.

Contact with Chlorine (Cl)

Concentration Limits:

Concentration of free (or active) *Chlorine:*	Potable Water, 20°C, pH 7
Drinking Water ‡	0.3 ppm (max)
316 Stainless	**5 ppm (max)**
Note: Chemicals containing hypochlorite are not suitable at any concentration!	

‡ The Australian water regulations allow dosing with up to 1.2ppm of free chlorine in the disinfectant solution, provided a limit of 0.3ppm of free chlorine is not exceeded in the ambient drinking water.

Disinfecting:
For commissioning or in the case of microbial contamination *Hydrogen peroxide* is recommended to disinfect pipework (ADWG).

Chlorine may also be used **for a limited time. Chemicals containing hypochlorite are not suitable at any concentration!**

After treatment, the system shall be flushed with ambient potable water to remove the higher *Chlorine* concentrations.

Disinfection time and free *Chlorine* concentration limits to prevent damage to 316 stainless:

	Option 1	Option 2
'Free *Chlorine*' in disinfection water at 20°C, pH 7:	100ppm (max)	50ppm (max)
Contact time (max):	16 hours	24 hours
Post dosing (after contact time) flush requirements:	Use potable water with 'free chlorine' levels less than 1 ppm.	

Stagnant Water

If the system is to be emptied again after a water pressure test or not to remain completely full of water, it is advisable to conduct the pressure test with air in order to avoid an increased risk of damage to the stainless steel. The same risk exists if the system is drained or partially drained for maintenance for an extended period of time.

Water Hardness

Hard water can cause build-up of solids within the pipework, accelerates as temperature increases, generally from CaCo3 concentration. Classes: 0 - "soft" - 60 - "medium" - 120 - "hard" - 180ppm. Adelaide: 134-148ppm; Melbourne: 10-26ppm; Perth: 29-226ppm; Brisbane: 100ppm.

© 2023 AusPress Systems Pty Ltd. This document is intended as a guide only and specific assessment must be made for each project for suitability. No responsibility is taken for any errors or omissions, contained or implied in this document. Document may be updated or corrected at anytime without notice.