Stainless Steel in the Airspace of Indoor Pools
IMPORTANT WARNING for designers, owners and operators of indoor

Stainless steel is widely used in and around swimming pools and performs exceptionally well in most applications. Handrails and other fixtures are strong, durable and look attractive. They are easy to keep clean, and require little or no maintainence for the life of the pool.

However, some common types of stainless steel are not suitable for use in the airspace of indoor pool buildings in certain applications where they are subject to tensile stress. In these circumstances a phenomenon known as **stress corrosion cracking (SCC)** can occur, with potentially tragic consequences.

SCC occurs under a unique set of circumstances found in the airspace of indoor pool buildings where the pool is sanitised with chlorine. Research into SCC does not suggest that outdoor pools are affected.

ASSDA has prepared the following advice to assist those who design and manage indoor pools to avoid the danger of SCC.

WHAT IS SCC?

Stress corrosion cracking causes microscopic cracks in the stainless steel, eventually resulting in failure. It is particularly dangerous because it can cause collapse without warning. It can only affect stainless steel under tensile stress, that is, elements such as fasteners, rods or wires which are supporting a load or from which a load is suspended. Residual fabrication and welding stresses can also cause vulnerability to SCC.

SCC is triggered by attack from corrosive chemicals present in atmospheric conditions of indoor pools, which can occur even at room temperature.

The SCC failure mode can occur in most metals under particular conditions of stress and corrosive attack. Stainless steels are no exception, and when SCC failure occurs there is no obvious warning.

ASSDA strongly urges pool designers, owners and managers to take preventive action to avoid injury to pool patrons, by not using potentially susceptible stainless steel grades in load-bearing applications in pool buildings.

WHAT CAUSES SCC IN POOL BUILDINGS?

In warm, humid conditions, chlorine reacts with ammoniacal body products to form volatile chloramines. Gaseous chloramines permeate the pool building and are absorbed by condensation in the cooler parts of the building, typically settling on structural components high up in the building's airspace. As the condensation evaporates, chloramines concentrate, becoming more aggressive. Under these conditions, stainless steel may be corroded, and members in tension may suffer SCC. Catastrophic failure of the member may result, and the load it was supporting may fall. The problem is particularly likely to occur in the new leisure centre type complexes, where the pool is kept at relatively high temperatures. There is often also intensive use, requiring higher rates of chlorine dosing to disinfect the water.

Where ozone disinfection is the only method of disinfection used, the warning in this bulletin do not apply as failure by SCC is unlikely. However, SCC may be a threat where a back-up chlorine system is in place.

WHAT IS AFFECTED BY SCC AND HOW CAN IT BE PREVENTED?

SCC only happens in the airspace of indoor pools and only where chloramines accumulate on stainless steel elements which are under tensile stress.

The vast majority of typical swimming pool components are unaffected. SCC does not affect stainless steel components which are immersed or regularly drenched, which aren't under tensile stress, such as:

- benches
- pool ladders
- safety rails
- doors and windows.

SCC has not been found to be a problem in these applications.

As SCC only occurs under a specific set of conditions, it can be effectively controlled through careful pool design (including ventilation) and stainless steel grade selection coupled with appropriate managment of bather load and water conditions.

The grades of stainless steel which are known or suspected to be susceptible to SCC in these conditions are the common "18/8" grades such as 303, 304 and 316. Not enough is known about duplex grades such as 2205 to recommend them in this environment.

The typical fittings at risk are those holding up:

- light fittings
- air conditioning ducts
- signage
- wall/ceiling panels
- suspended ceilings.

Stainless steel rigging and bracing are also vulnerable to SCC. All these elements should be specified in grades suitable for safety-critical use, such as 904L or a super-austenitic 6% Molybdenum alloy.

Ongoing measures for avoiding SCC risks include:

- monitoring and controlling pool chemical levels
- preventing excessive bathing loads
- providing good shower and toilet facilities and clear instructions to patrons
- monitoring and controlling air quality
- instituting a regular inspection and cleaning program as outlined below.

INSPECTION AND CLEANING REGIME

An inspection program should be instituted as a first step. ASSDA recommends that pool owners and managers compile an inventory of stainless steel parts which may be at risk of SCC and engage a qualified engineer to undertake assessment which may include:

- cleaning
- visual examination at x10 magnification
- flexing wires or clips
- tightening and loosening fasteners.

A dye penetrant test is also an option.

Typical indications of SCC are brown stains on the stainless steel but these can be inconclusive. If discolouration is found in a load-bearing, safety-critical location in the complex, samples should be tested for SCC. If a positive result is returned, it may be necessary to replace the affected components.

Expert advice should be sought to establish a course of action.

A cleaning and inspection regime should be put in place and scheduled no less than twice a year. Thorough cleaning using plenty of fresh water is needed to remove chloramine deposits. Simply wiping with a moist cloth is not sufficient.

Strict adherence to such a cleaning and inspection regime will reduce the risk of SCC but no assurance can be given that the risk will be eliminated.

Cleaning after cracks have commenced will not rectify the damage and components should be replaced immediately with a higher alloy stainless steel or another material.

Level 9, 307 Queen Street
Brisbane, QLD AUSTRALIA 4000
www.assda.asn.au

T +61 7 3220 0722
E assda@assda.asn.au