Pipeline & Heating Solutions

# Stress Corrosion Cracking in Copper-Zinc Alloys

## What is Stress Corrosion Cracking (SCC)?

When subjected to the combined effects of stress and corrosion, many alloys can develop cracks over a period of time and specifically copper-zinc alloys such as brass can be sensitive to stress corrosion attack, particularly in the presence of moisture through condensation.

However, SCC occurs only in the presence of a sufficiently high tensile stress and a specific corrosive environment. For brasses, the environment involved is usually one containing ammonia or closely related substances such as amines. The presence of ammonia or related substances could typically arise from the insulation material or from various sources of chemicals used on an installation and may even be airborne.

Since all brasses are susceptible to stress corrosion cracking it is important to avoid the combination of high stress and unfavourable environment that may cause stress corrosion.

Stress corrosion cracking of joints can occur with quite low concentrations of ammonia and may be accompanied by black staining of the surrounding surface. SCC is usually localised with the cracks running roughly perpendicular to the direction of the tensile.

## Condensation and Insulation

Condensation of water vapour will occur on a surface that is at a temperature below the atmospheric dew point temperature due to the water vapour being drawn towards the cold surface as a result of a difference in partial vapour pressure between the air at ambient temperature and that at the temperature of the cold surface. Without adequate vapour sealing, moisture can be deposited through condensation within the insulating material and on the insulated metal surface.

Precautions must be taken to exclude moisture (condensation) from the system, therefore an effective vapour barrier is required. The purpose of the vapour barrier is to reduce, and if possible to prevent, the ingress of water vapour into the insulating material and it must be applied before the water in the pipe is cooled. Any joints in the insulating material must be fully sealed to ensure vapour permeance maintained continuously. Particular care must be taken at termination points to ensure that the integrity of the insulation and vapour barrier is maintained.

Only dry insulation material should be used and it should be kept dry until after the vapour barrier has been applied. Unsealed joints, badly fitting insulation and inadequate vapour sealing of termination points such as valve headworks and stems and test points can provide an easy passage for water vapour and subsequent condensation. Pipe supports should not be attached directly to the pipe because it is difficult to seal the insulation surface where the support projects through, therefore the pipe support brackets should be clamped over the exterior of the insulation where possible.

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## Systems

Copper alloy valves and fittings are widely used throughout HVAC systems on hot water heating, chilled water and domestic hot and cold water. It is reasonable to assume that fitting practices are the same throughout all the systems but failure due to stress corrosion cracking (SCC) is almost invariably encountered with brass products in chilled water systems. Nickel plating of products does not provide protection against SCC.

Products manufactured in bronze are not susceptible to SCC and DZR brass products are also less susceptible.

## Installation

Joints must be made in accordance with our installation instructions. Correctly fitting tools such as spanners must be used to avoid causing damage and localised stressing to the component. 'Stilson' type wrenches must not be used. Excessive use of jointing material combined with high tightening forces can generate high hoop stresses in female threaded components.

Where failure does occur as a result of SCC, the stresses involved will almost always have been generated during installation.

## Reduce the Risk of SCC

- Preferably install products manufactured in bronze or DZR brass material. If DZR brass is installed, the use of compression ended components is not recommended.
- Ensure that ball valves are supplied with extensions.
- All insulation and vapour barriers must comply with BS5970:2001 and BS5422:2009.