

Stress, Corrosion and Cracking

Copper alloys have an excellent corrosion resistance and if installed correctly can confidently be expected to provide trouble-free service above and beyond the manufacturers' guarantee period. Indeed many systems will last the entire lifetime of the buildings in which they are installed.

In order to achieve such longevity, designers and installers take basic precautions. Largely these precautions have been incorporated into various standards and codes of practice such as BS6700. These include the need for protection in certain aggressive or potentially aggressive environments in order to avoid external contamination.

What is Stress Corrosion Cracking?

Stress corrosion cracking occurs in duplex brasses and is commonly referred to as season cracking. In the case of copper alloy fittings, it is manifested by the appearance of intergranular cracking, usually (but not always) disposed along the longitudinal axis of the component. It is due to four essential factors:

- Residual Stress in the Fitting
- A Stress Cracking Agent
- Moisture
- An Alkaline Environment

How does Stress Corrosion Cracking occur?

Development of stress corrosion cracking depends on simultaneous occurrence of the following four factors:

(a) Residual Stress in Copper Alloy Fittings (duplex or yellow brasses).

During most stages of the manufacturing process copper alloy fittings are cold worked which leads to the presence of residual stress. Additional stresses are introduced through further cold working such as tightening in threaded connections and compression fittings, etc., during installation.

However, it should be borne to in mind that stresses introduced during manufacture or subsequent cold working operations are normally of no consequence, as evidenced by the many millions of copper alloy fittings giving excellent service throughout the world. Problems arise only when copper alloy fittings are exposed to specific stress cracking agents (see b) under unfavourable conditions (see c & d).

(b) Stress Cracking Agents.

There are specific stress-cracking agents for brasses, these are usually ammonia (or its derivatives). If moisture is present in an alkaline environment it may absorb ammonia and such solutions, in conjunction with residual stress, can initiate stress corrosion cracking. Potential sources of ammonia or ammoniacal derivatives are:

- Decomposing organic detritus
- Refrigeration gases
- Nitrogenous fertilisers
- Urine

Certain types of:

- Domestic chemical cleaners
- Floor tile adhesives
- Concrete additives
- Insulation materials

(c) Moisture.

Moisture can arise from various sources including soils, cement or concrete, condensation, etc. However, it should be noted that moisture generally poses no problems for copper alloys, it is only when the moisture absorbs aggressive constituents from component surroundings that problems may arise.

(d) An Alkaline Environment.

Alkalinity in itself does not cause stress corrosion cracking and indeed copper alloys generally have good corrosion resistance in alkaline environments. Nevertheless, for stress corrosion cracking to occur, the environment needs to be of an alkaline nature. Thus with plaster and concrete being predominantly based on alkaline cement, most construction sites can be considered to be alkaline. Also certain insulation materials have an alkaline reaction if they become wet.

IBP's Advise for Installers

Adherence to good installation practice will normally prevent the necessary combination of factors and hence any risk of this relatively rare form of cracking.

This applies to:- Conex Compression Fittings and Valves, >B<Push and Conex Pushfit fittings,

For Conex Compression

- the use of good quality flat-faced spanners, that do not damage the capnut when being tightened. Fittings should not be over tightened.
- Serrated jaw wrenches, such as 'Stilsons' should not be used as these can introduce additional stresses.
- For compression fittings above 28mm, an application of a light oil to the threads will reduce the force required to tighten the fitting, and thus reduce stress.

For all of the above products.

- Care must be taken when tightening male taper threads in female parallel threads so not to over tighten – the use of PTFE tape, or an approved sealant is recommended. Hemp must not be used.
- Chilled water applications are one of the highest risk areas that are likely to suffer from stress corrosion cracking due to the presence of moisture, alkalinity, and stresses in brass. It is essential to ensure there is no stress-cracking agent (as outlined above) in the vicinity of the installation, including pipework insulation materials. If there are any doubts, then IBP recommends Conex >B< Press fittings, or Conex Cuprofit copper fittings as alternative jointing systems.
- Where conditions are likely to be conducive to the development of stress corrosion cracking, it is recommended that **ALL YELLOW BRASS** fittings be protected from aggressive moisture by the use of an appropriate impervious tape spirally wrapped around the fitting(s). However, it should be borne in mind that insulation materials are primarily designed to reduce heat loss and they should not be considered to be a protective medium unless stated otherwise by the lagging manufacturer.

- In summary, installers should ensure **ALL YELLOW BRASS FITTINGS AND VALVES** are not over tightened, and that the environment into which they are installed is not detrimental as outlined above.

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