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To	All Surveyors/Auditors
Applicable to flag	All Flags
Title	**Pitting Corrosion Prevention**
Reference	CONARINA Instruction

Pitting Corrosion Prevention

At first glance, pitting corrosion looks like a tiny localized type of electrochemical deterioration found on metallic surfaces that often goes unnoticed. However, it could be a dangerous form of deterioration from a material integrity point of view. On the surface it might appear to be confined to a tiny point or spot, whereas underneath it can often spread over large areas at various depths. This damage underneath the surface can cause significant loss of strength for metallic structures and components.

Onset and Severity of Pitting

Pitting corrosion normally occurs on the surfaces of passive or passivated metals such as steel alloys, stainless steels and aluminum. The onset of pitting corrosion can occur wherever the passive layer (oxide layer) is partially damaged and the damage is not automatically repaired by re-passivation; this can cause significant perforations across the thickness of a metallic structure.

The characteristics of the passive film play a decisive role in the initiation of the pitting, the rate of pit growth and re-passivation of the corroded surfaces. Because the pitting damage can spread in multiple directions, the pit's dimensions are found by metallography.

The severity of the pitting corrosion is dependent upon the pitting factor, which is the ratio of the depth of the deepest pit to the average pit depth (i.e., the average pit depth is found on the basis of the resulting weight loss due to the pits).

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Factors that Influence Pitting Corrosion

Material defects such as inclusions, surface quality and corrosive chemicals such as chloride salts present in the environment are the main factors responsible for any initial pit formation. Metal oxide layers acting as passive films are easily attacked by the chlorides. Automatic healing or re-passivation of the pit may begin only if a supply of oxygen is ensured through continuous aeration at the site of pit initiation. Re-passivation is also facilitated by alloying elements such as molybdenum, vanadium and chromium present in the metal.

Pitting can occur on an exposed metal substrate, where anodic reactions (oxidation) are constricted inside the particular pits and the balancing cathodic reactions (reducer reactions) occur in the adjacent areas. The presence of strong stagnant electrolytes as well as surfaces with imperfections can also contribute to pitting activity.

For a given metal the resistance to pitting corrosion is evaluated on the basis of its critical pitting temperature (CPT). For steel alloys and stainless steel, the critical pitting temperature is determined by the procedure specified in ASTM G48 E (applicable CPT procedure for stainless steel) and ASTM G48 C (applicable CPT procedure for nickel chromium based alloys).

Patterns of Pitting Corrosion

Pitting corrosion may be difficult to recognize with the naked eye as it may be covered with a layer of corrosion product. A coating defect can also produce pitting under the coating. Holes or cavities that develop underneath the initial pit may take different patterns such as narrow, elliptical or round pits, grain attack pits (horizontal), subsurface sideway pits, vertical (grain attack) pits or wide-shallow pits.

Implications of Pitting Corrosion

Loss of wall thickness (i.e., wall loss) of structural members and pipes has important implications for various mechanical capabilities such as flexibility, tensile strength and compressive strength. An innocuous pit can become a stress raiser, cause initiation of failure due to stress corrosion cracking (SCC) or fatigue cracks, and even result in the catastrophic collapse of structures or ruptured piping with disastrous consequences.

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Prevention of Pitting Corrosion

Preventive action to avoid pitting corrosion damage involves:

1. Monitoring the chloride and sulfate concentrations
2. Selecting materials with the appropriate pitting corrosion resistance as required for the service conditions

In addition, providing a corrosion-resistant coating or cathodic protection may be necessary in some cases.

Conclusion

The failure risk that can be posed by the tiny pitting corrosion marks on metallic surfaces is very real and significant. These marks are a result of tiny breaks in the passive film that otherwise protects stainless steels, aluminum and other alloy metals where corrosive chemicals have attacked the surface. Pitting corrosion can be prevented by choosing metals with appropriate pitting corrosion resistance and by protecting the surfaces with cathodic protection and protective coatings.

REFERENCES:

- CONARINA Instructions

- ATTACHMENTS: No

Kindest Regards,

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