Sammenslutningen
for Pålideligheds- og
Miljøteknik

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Corrosion protection of electrical contacts in humid environments

A guide based on practical experiences

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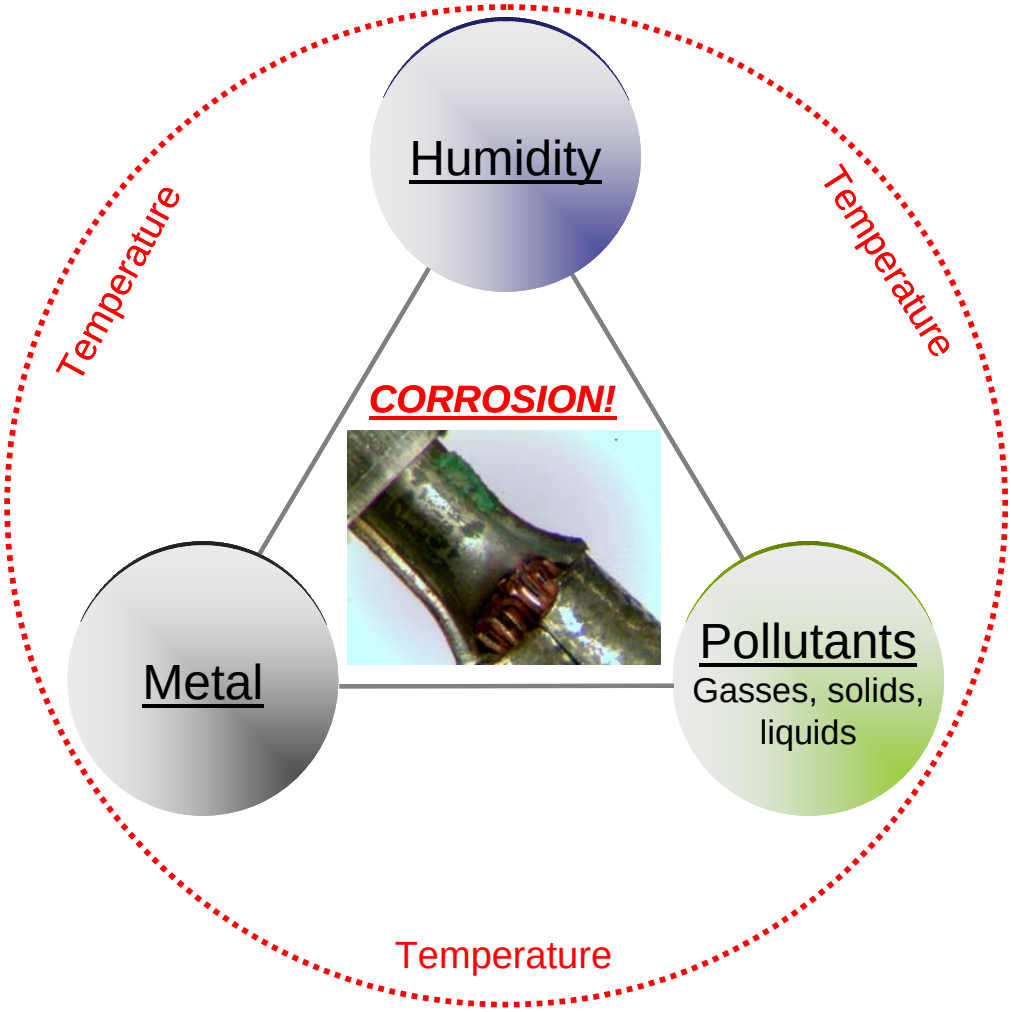

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SPM

Society for Reliability and Environmental Testing

SPM is an independent organisation consisting of about 75 company members in Scandinavia.

SPM initiates and finances unprejudiced investigations of common interest for its members – mainly in the field of reliability and testing of electronic components and materials.

Abstract

This report will help the reader with background information about possible design solutions and strategies for electrical contacts – the key components of a separable electrical connection – to be used in humid/corrosive environments.

The presence of humidity above a certain level is a key catalyst for “atmospheric corrosion” of electronics in general and very often the most vulnerable points are the electrical contacts.

Electrical contacts exposed to uncontrolled “normal” atmospheric conditions (most outdoor environments, off-shore, farms, traffic, industry etc.) may corrode – even if they are not directly exposed to rain, splashing water or other liquids.

As will be evident after studying the subject of contact corrosion and failure mechanisms, the task of choosing a corrosion protected design for a particular environment is – in many cases – far from obvious. Very often the “design choice” in a practical situation means selecting the right connector from the many available variants – all capable of doing the job according to the manufacturers!

This report is a result of gathering information from a number of sources, including engineers with many years of experience in corrosion of electronics in a number of different humid environments (farms, automotive, off-shore, aerospace, greenhouses etc.). The information and experiences gathered have been compiled to give the reader an adequate mixture of theory and practical experience in the form of guidelines.

The report can, for instance, be used by the many designers of electronics, who in spite of their comprehensive knowledge about equipment design are not too familiar with the special considerations applying to contact and connector design in humid environments. Furthermore, it can be used to guide the reader in the right direction and ask the “right” questions to the manufacturers.

Although the report mainly gives reference to electrical contacts in housings (connectors, screw-terminals etc.) the information can also be applied to other types of contact applications.

A number of environmental tests and measurements of separable electrical connections were carried out in the project. The purpose of the tests was to show examples of typical corrosion related failures for electrical contacts in humid/corrosive environments and investigate some of the design solutions suggested in the guidelines.

Preface

Background

The subject “corrosion of electrical contacts” encompasses all areas of classical physics: Tribology, electrical engineering, chemistry, materials, mechanics and quantum effects {A1}. Consequently, special knowledge and – even better – field experience is needed in order to judge and evaluate use environments for corrosion risk and choose the right contact design to avoid problems.

In recent years several connector manufacturers have merged and grown significantly in size. This has made it increasingly difficult for smaller companies to get help and advice on specific contact applications and in-field problems. Typically, one is left with a datasheet from the Internet containing only scarce information of doubtful relevance, especially for the judgement of corrosion resistance.

Even though several comprehensive books on the subject exist, SPM members showed great interest in a simpler and more specific “tool” that could be helpful in the process of preventing problems with corroded electrical contacts.

Due to the above, it has been the author’s ambition to make a compilation of existing knowledge specifically addressing the subject, combined with practical experiences in the form of easy-to-use guidelines.

The following persons, in particular, have provided valuable information and experience during this project:

Fred Andersson (former DeLaval International AB), Rajan Ambat (IPLA, DTU), Henrik J. Larsen (Vestergaard Company A/S), Magnus Nilsson (Volvo 3P), Lars Rimestad (Grundfos A/S), Kennet Palm (MAN Diesel A/S), Brian Kristiansen (Furuno Denmark A/S), Chris Pillbeam (former DELTA), Bjørn B. Petersen (DELTA) and Kim A. Schmidt (DELTA).

Readers

The report is intended for the non-specialist, however, those already familiar with electrical contacts and corrosion can proceed directly to the tests in chapter 5 and guidelines in chapter 6. Furthermore, the referenced literature (hard copies in [ ] brackets and CD references in { } brackets) includes various books, reports and articles with detailed information about specific subjects related to contact corrosion.

The report contains a rather large number of references, which should be considered only as informative i.e. to provide additional information, not as required reading for understanding the contents of the report.

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