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Basic environmental testing procedures - Part 2: Tests - Guidance to Test Kd: Hydrogen sulphide test for contacts and connections

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BASIC ENVIRONMENTAL TESTING PROCEDURES
PART 2: TESTS
GUIDANCE TO TEST Kd: HYDROGEN SULPHIDE TEST FOR CONTACTS AND CONNECTIONS

Essais fondamentaux climatiques et de robustesse mécanique
Deuxième partie: Essais
Guide pour essai Kd: Essai à l'hydrogène sulfuré pour contacts et connexions

Grundlegende Umweltprüfverfahren
Teil 2: Prüfungen
Leitfaden zur Prüfung Kd: Hydrogensulfid für Kontakte und Verbindungen

BODY OF THE HD

The Harmonization Document consists of:

- IEC 68-2-46 (1982) ed 1; IEC/SC 50B, not appended

This Harmonization Document was approved by CENELEC on 1 March 1988.

The English and French versions of this Harmonization Document are provided by the text of the IEC publication and the German version is the official translation of the IEC text.

According to the CENELEC Internal Regulations the CENELEC member National Committees are bound:

to announce the existence of this Harmonization Document at national level by or before -

to publish their new harmonized national standard by or before 1989-03-01

to withdraw all conflicting national standards by or before -

Harmonized national standards are listed on the HD information sheet, which is available from the CENELEC National Committees or from the CENELEC Central Secretariat.

The CENELEC National Committees are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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Basic environmental testing procedures

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

BASIC ENVIRONMENTAL TESTING PROCEDURES

Part 2: Tests — Guidance to Test Kd: Hydrogen sulphide test for contacts and connections

FOREWORD

1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by Sub-Committee 50B: Climatic Tests, of IEC Technical Committee No. 50: Environmental Testing.

A first draft was discussed at the meeting held in Paris in 1979. As a result of this meeting, a draft, Document 50B(Central Office)216, was submitted to the National Committees for approval under the Six Months' Rule in April 1980.

The National Committees of the following countries voted explicitly in favour of publication:

Australia
Belgium
Brazil
Bulgaria
Canada
Czechoslovakia
Egypt
Finland
Hungary
Israel
Italy
Korea (Democratic People's Republic of)
Korea (Republic of)
Netherlands
New Zealand
Norway
Poland
South Africa (Republic of)
Spain
Sweden
Switzerland
Turkey
Union of Soviet Socialist Republics
United Kingdom
United States of America

Other IEC publications quoted in this standard:

Publications Nos. 68-2-42: Part 2: Tests - Test Kc: Sulphur Dioxide Test for Contacts and Connections.

355: An Appraisal of the Problems of Accelerated Testing for Atmospheric Corrosion.

BASIC ENVIRONMENTAL TESTING PROCEDURES

Part 2: Tests—Guidance to Test Kd: Hydrogen sulphide test for contacts and connections

1. Introduction

Satisfactory performance during the desired lifetime of contacts and connections depends on many parameters, some of them determined by their design (type, materials, forces, etc.) and others by the environment in which they have to function. Concerning the effects of the environment, special attention must be paid to the polluting substances contained—usually in very small amounts—in the atmosphere.

Silver and some of its alloys are peculiarly susceptible to tarnishing by the minute quantities of hydrogen sulphide that occur in many environments. The tarnish product is dark in colour and consists largely of β-silver sulphide.

Separable electrical connections employing these metals as contact materials may therefore suffer from increased contact resistance and contact noise as a result.

2. Hydrogen sulphide in the atmosphere

Hydrogen sulphide is evolved by bacterial reduction of sulphates in vegetation, soil, stagnant water and animal waste. In the atmosphere it is readily oxidized to sulphur dioxide, which is brought to the ground by rain. Where the soil is aerobic, certain bacteria turn the sulphur dioxide to sulphates. When or where rotting organic matter generates anaerobic conditions, sulphate reducing bacteria complete the cycle and turn the sulphate to hydrogen sulphide, which is the principal natural sulphur input in the atmosphere. It is therefore a widespread pollutant in air.

Sulphur dioxide will accumulate in the atmosphere when it is not rinsed by rain. In urban areas burning of fossil fuels emits sulphur dioxide into the atmosphere. The content can be 10 times to 1 000 times that of hydrogen sulphide and becomes the dominant cause of corrosion. In equal concentration, hydrogen sulphide is the more corrosive of the two, particularly on silver and copper. (See IEC Publication 68-2-42: Part 2: Tests—Test Kc: Sulphur Dioxide Test for Contacts and Connections.)

Although the major input to the sulphur cycle is by hydrogen sulphide through natural processes, industrial processes also play a part. Oil refineries, chemical plants and gas works are all possible sources. Atmospheric concentrations of 1 ppb to 30 ppb (parts in 10^9 by volume) are commonly reported. At many sites peak values exceed this, and much higher concentrations are found close to sources. Table I, page 17, illustrates a typical statistical distribution of measurements of hydrogen sulphide concentration. Table II, page 19, lists representative concentrations at a range of sites. These levels are sufficient to account for the natural tarnishing of silver. Other sulphurous pollutants are much less important.

Sulphur dioxide has little effect on silver unless the concentration and humidity are high, and then it produces a tarnish product that is rarely found in practice. The two commonest organic sulphurous pollutants: methyl mercaptan and carbon disulphide do not tarnish silver at all. Some organic sulphur derivatives do tarnish silver, as does elemental sulphur vapour, but these materials probably occur only in a small minority of environments.

3. Object and scope of the test

3.1 *Types of contacts and connections*

As this test is specifically intended for certain types of contacts and connections (other than those of the welded or soldered type), a short description of these types of contacts and connections is considered to be useful.

Contacts and connections may be divided into two types and could be described as permanent or temporary. In both cases, metal surfaces are held together by an external force.

In the case of permanent connections, the force is very great and will usually cause permanent deformation of the metals and it is possible that a form of local welding takes place. Such connections are not intended to be made and broken during their lifetime. Examples of permanent connections are crimp and wrap joints.

With temporary connections, the force holding the metals in contact is by comparison light and they are of course designed to be made and broken possibly very many times during their lifetime. Examples of temporary connections are: connectors, switches and relays. In temporary connections the areas of metal which make contact with each other are in some cases referred to as contacts.

The contacts or contact areas in temporary connections will be made of various metals according to duty and application. Most metals—with the exception of precious metals—suffer from atmospheric corrosion. When contact materials corrode, contact resistance increases. The extensive use of precious metal contacts would be costly, so it is common in many applications to use precious metal alloys or coatings of precious metal or alloys over base metals for contact materials.

In the case of permanent joints, it is not normal to use precious metals and some general corrosion of external surfaces by hydrogen sulphide must be expected. But, in a properly designed and made crimp or wire wrap joint, corrosion does not occur between the contact surfaces due to the cold weld and high pressure. However, in joints that are poorly made or weakened as a result of thermal cycling, corrosive gas will penetrate into those contact areas with a resultant increase in contact resistance.

3.2 *Object of the test*

The test has been devised to assess the consequence of tarnishing of silver and some of its alloys. It has been largely validated by laboratory and field tests on silver, though limited tests have also been carried out on components with contacts of some silver alloys.