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## **Anodizing of aluminium and its alloys — Experimental research on possible alternative sealing quality test methods to replace the phosphoric acid/chromic acid immersion test — Evaluation of correlations**

*Anodisation de l'aluminium et ses alliages — Recherche expérimentale sur les méthodes alternatives possibles d'essai de qualité de colmatage pour remplacer l'essai d'immersion dans l'acide phosphochromique — Évaluation des corrélations*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 16689 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 2, *Organic and anodic oxidation coatings on aluminium*.

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## Introduction

The chromic/phosphoric acid solution (CPA) test is the main test used internationally to assess the quality of sealing of anodic oxidation coatings on aluminium. The method is described in ISO 3210<sup>[1]</sup>, ASTM B680<sup>[2]</sup>, EN 12373-6<sup>[3]</sup> and EN 12373-7<sup>[4]</sup>. ISO 7599<sup>[5]</sup> and EN 12373-1<sup>[6]</sup> designate it to be the referee test, as do the voluntary standards of Qualanod<sup>[7]</sup> and the AAMA (American Architectural Manufacturers' Association)<sup>[8]</sup>.

The CPA test was originally proposed by two workers at Alcoa, J. H. Manhart and W. C. Cochran, in the early 1970s<sup>[9]</sup>. They compared it for hot-water sealing with various simple laboratory tests including other acid dissolution tests, some of which were in regular use at that time and were described in ISO 2932<sup>[10]</sup>. Since the adoption of the CPA test, practical experience has revealed that low-coating mass loss is an indication of good sealing quality and of the ability of the coating to resist staining and blooming in many types of service.

There is mounting concern in Europe over the use of this test because the test solution contains hexavalent chromium [Cr(VI)] which is a human carcinogen via inhalation. Chromic acid was included, 2010-12-15, in The European Chemicals Agency candidate list of substances of very high concern for authorization. Special authorization will have to be obtained for the use of such substances in every application.

In 2007 Qualanod initiated a study to identify potential alternative tests. It was decided to restrict this to acid dissolution tests because it was expected that they would behave in a manner most similar to the CPA test. A list of criteria was drawn up for alternative tests to be assessed against. These criteria included ones that would favour easy-to-use immersion tests. The technical literature was reviewed and a shortlist of tests produced.

The next stage was to carry out experimental work to determine whether the alternative tests were comparable to the CPA test for a range of sealing methods. Sapa Technology offered to undertake this project. Sapa found that neither of the acid immersion tests evaluated were suitable alternatives to the CPA test. This was because they responded very differently depending on the sealing method. It is believed that the response of any immersion test is dependent on the solution composition. Sapa also found that the admittance test was good at distinguishing sealing quality for all the sealing methods. However, admittance is a property of the whole of the anodized coating whereas the CPA test is surface-specific, providing a prediction of the likelihood of surface degradation during service.

This Technical Report contains an edited version of Sapa Technology technical report D09-0179<sup>[11]</sup>.

It is believed that future investigations should focus on finding a test method that will enable the prediction of superficial, cosmetic degradation during exposure to the weather. This would not include the ability of an anodized coating to protect the aluminium from pitting corrosion, which can already be assessed using a salt spray test. Rather, it would assess the susceptibility to weathering effects such as staining, blooming, chalking, resmutting and iridescence.