INTERNATIONAL STANDARD

ISO 22910

First edition
2020-08

Corrosion of metals and alloys — Measurement of the electrochemical critical localized corrosion temperature (E-CLCT) for Ti alloys fabricated via the additive manufacturing method

Corrosion des métaux et alliages — Mesurage de la température critique de la corrosion localisée électrochimique pour les alliages de Ti fabriqués à l'aide d'une méthode de fabrication additive

Reference number
ISO 22910:2020(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Ti alloys such as Ti-6Al-4V are considered the most promising engineering materials. Due to a unique combination of high strength-to-density ratio and increased mechanical and corrosion resistance, their applications are growing in a wide range of industries, e.g. aerospace, automobile, marine and biomedical fields.

Ti alloys are conventionally produced by wrought or cast processes, which are subtractive manufacturing (SM) methods. The recent emergence of a new additive manufacturing (AM) method known as “3D printing” has gained worldwide attention as a way to cut costs and improve efficiency for small quantity, batch productions.

Additively manufactured Ti alloys are extensively investigated for their usage in aerospace and medical applications. When AM is compared with conventional manufacturing, the buy-to-fly ratio is known to be around 15:1 (conventional). In terms of mechanical viewpoints, both the strength and ductility of Ti alloys such as Ti-6Al-4V fabricated via AM are comparable to or superior to those developed via conventional manufacturing methods, because of their unique microstructure based on laser or electron beam technologies. However, the characteristics of additively manufactured alloys are highly dependent upon the geometric and processing conditions (and there are over 130 variables) such as layer formation (imbedded or sprayed), size and quality of powder or wire, dimension, input energy, layer orientation and surface conditions, and tolerance in the CAD process, which converts the data into additive layers for building parts. The differences in layer orientation and the porosity generated by crossing hatches during the layer-by-layer fabrication process can result in differences in both mechanical and electrochemical properties in AM materials. Heat treatment controls the porosity or the microstructure derived from rapid melting and quenching; however, it cannot eliminate interlayers, which contribute to the differences in the mechanism of localized corrosion in AM materials. The resistance to corrosion of Ti alloys produced via AM is similar to that of conventionally manufactured Ti alloys. The mechanisms of corrosion also differ. Therefore, since the conventional testing methods have shown limited ability for evaluation of those properties, the new test method measuring electrochemical critical localized corrosion temperature (E-CLCT) has been developed to evaluate pitting and crevice corrosion in alloys generated via AM. E-CLCT is defined as the lowest temperature on the surface of the AM specimen on which localized corrosion to both pitting and crevice corrosion is initiated under specified test conditions.

This document specifies a procedure for evaluation of the resistance to localized corrosion on the AM alloys by measuring their E-CLCT, providing an efficient method for a qualitative evaluation or comparison of corrosion properties between AM materials or their heats with altered process variables. This test method demonstrates the quality of heat treatment, bonding integrities between layers, and effective control of variables for AM materials, providing a qualitative tool for long-term application. Furthermore, this document can extend its use from AM Ti-alloys to other AM alloys, such as Ni alloys by modifying the concentration of test solutions or the applied potentials. This document also provides important clues to evaluate other types of localized corrosion such as corrosion cracking and erosion-corrosion. Related documents can be developed and followed up based on the results of this test.