
**Corrosion of metals and alloys —
Requirements for localised corrosion
and environmentally assisted cracking
testing of additively manufactured
metals and alloys**

*Corrosion des métaux et alliages — Exigences pour les essais de
corrosion localisée et de fissuration assistée par l'environnement sur
les métaux et alliages de fabrication additive*





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Foreword

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Introduction

Additive manufacturing (AM) offers a route to rapid and delocalized end product generation, often with complex shapes, without the need for extensive machining, with the expectation of reducing cost, time and waste. For metals, AM products can be built using non-fusion based or fusion based technologies, the former being less common. The more established fusion based additive manufacturing methods are powder bed fusion, powder-feed fusion or wire-feed fusion depending on required size, speed and complexity. Powder-bed fusion tends to be used for relatively small products of complex shape and involves spreading the powder over the powder bed and melting the powder to the shape required using a programmed laser beam (under inert gas such as argon or nitrogen) or electron beam (under vacuum). The next powder layer is spread uniformly across the powder bed and the process is repeated to build up the full part. In powder-feed directed energy deposition, the powder is fed through a nozzle onto the build surface under an inert gas. The beam creates a meltpool into which powder is fed and the process is repeated layer by layer to create the desired shape. In wire-feed systems, the feedstock is wire but the energy source can be electron beam, laser beam or plasma arc under inert gas or vacuum as appropriate. Initially, a single bead of material is deposited and this is built upon in subsequent passes. Wire-feed systems are used when large build volumes are desirable.

It is important to recognize the possible challenges in deploying these products, including the inhomogeneous and graded microstructure, microstructural grain/dendrite size distribution, phase distribution, strong crystallographic texture, elemental segregation, residual stress, surface properties, shrinkage fissures, pores and anisotropic mechanical properties. Some of these factors impinge on corrosion and environmentally assisted cracking resistance (see Reference [1]) and how it is measured. Post-processing thermal treatments are commonly applied to homogenize the material and these can reduce the impact in some cases. Also, the degree to which the factors listed affect properties is highly dependent on the specific AM process and process parameters adopted, and the manufacturer's expertise and experience. The difference in the quality of the end product is expected to diminish as the technology further matures.