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General requirements for cyber-physically controlled smart machine tool systems (CPSMT) —

Part 3:
Reference architecture of CPSMT for additive manufacturing

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Foreword

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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).

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This document was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 1, *Industrial cyber and physical device control*.

A list of all parts in the ISO 23704 series can be found on the ISO website.

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

According to ISO/ASTM 52900, additive manufacturing (AM) is the process of joining materials to make a part from 3D model data usually layer by layer. With the advancement of various feedstocks, process technologies, and product design methodologies, AM contributes to realizing customized production, which is the key objective of Industry 4.0. Also, AM allows construction of complex geometry and other features that were previously impossible or impractical to manufacture.

Many institutions have long been devoted to technological development from the viewpoint of reducing downtime and defects and are considering smart technologies such as Internet-of-Things (IoT) as a new means to achieve this.

From the market perspective, many institutions have released various smart additive manufacturing systems (SAMS) based on their own concepts and local terminologies. This makes stakeholders confused about the common concept of SAMS, including end-users. For this reason, standards and substantial modelling for a SAMS are needed.

From the standards perspective, for standards on contemporary AM technology, there is a set of standards and a roadmap from ISO TC261/ASTM F42. For standards on smart manufacturing, RAMI 4.0 (IEC/PAS 63088) and IEC TR 63319 TR-SMRM provide a reference model for smart manufacturing on a high level. Even though some standards deal with Industry 4.0 enabling technologies, e.g. OPC-UA (IEC/TR 62541-1 and Reference [67]), MTConnect (ANSI/MTC1.4-2018), ISO/IEC 30141, IEC 62769, there are no standards specifying the SAMS.

The ISO 23704 series specifies general requirements on smart machine tools for supporting smart manufacturing in the shop floor via cyber-physical system control scheme, namely cyber-physically controlled smart machine tool systems (CPSMT).

Figure 1 shows the overall structure of the ISO 23704 series, including:

— Overview and fundamental principles of CPSMT in ISO 23704-1;

— Reference architecture of CPSMT for subtractive manufacturing in ISO 23704-2;

— Reference architecture of CPSMT for AM in ISO 23704-3.

Other related parts such as implementation guideline or reference architecture for other types of manufacturing will be added if and when necessary

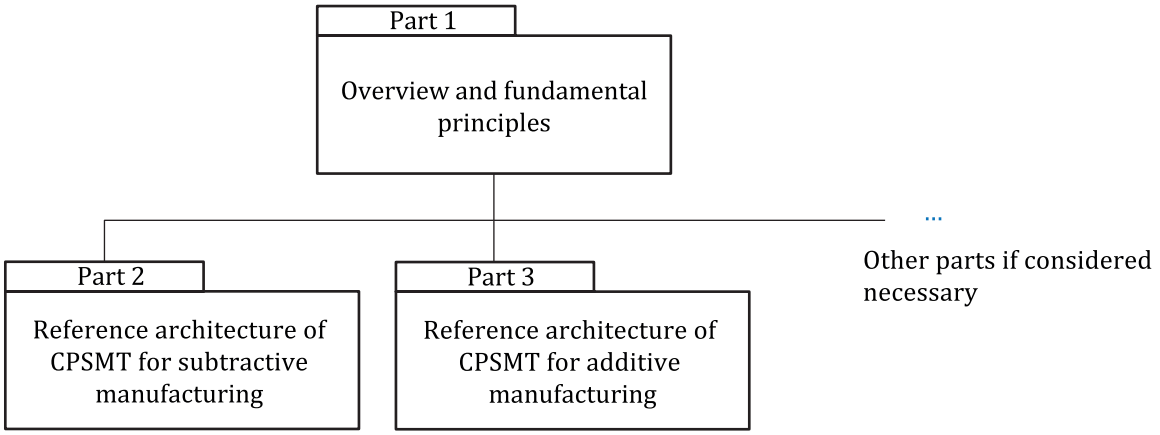

Figure 1 — Overall structure of the ISO 23704 series on general requirements for cyber-physically controlled smart machine tool systems (CPSMT)

This document can be used as a reference and guidelines for stakeholders such as, but not limited to:

— Design engineers in the area of SAMS,

- System architects in the area of SAMS,
- Software engineers working with the AM machine builders in the area of SAMS,
- Machine tool control vendors in the area of SAMS,
- Solution and service providers in the area of SAMS, and
- End users such as factory operators working with SAMS.