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

**Part 1:
Overview and fundamental principles**

*Exigences générales relatives aux systèmes de machines-outils
intelligents à commandes cyber-physiques (CPSMT) —*

Partie 1: Vue d'ensemble et principaux fondamentaux



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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.

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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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 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

A machine tool is a key device in manufacturing since it is used indispensably in the production of machine parts used in various industrial areas. Many institutions have long been devoted to technological development from the viewpoint of reducing downtime and defects and are considering smart technologies such as the Internet-of-Things (IoT) as a new means to achieve this.

From the market perspective, there is a variety of so-called smart machine tools incorporating smart technologies based on their own concepts using, e.g. local terminologies by machine tool builders (MTBs), machine tool control, e.g. computerized numerical control (CNC) vendors, solution vendors and service providers, which can be confusing to stakeholders, including end-users. For this and other reasons, standards and substantial modelling for smart machine tool systems are needed.

From the standards perspective, RAMI 4.0 (IEC PAS 63088) and IEC TR 63319¹⁾ TR-SMRM provide a reference model for Industry 4.0 and smart manufacturing on a high level. The ISO 23247 series defines a generic framework to support the creation of a digital twin of observable manufacturing elements. Furthermore, although some existing standards deal with Industry 4.0 enabling technologies, e.g. OPC-UA (IEC/TR 62541-1), MTConnect (ANSI/MTC1.4-2018), ISO/IEC 30141, the IEC 62769 series, and many machine tool standards from ISO TC39, no standard yet exists for smart machine tools for realizing smart manufacturing / Industry 4.0 in the shop floor via cyber-physical systems (CPSs).

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 a CPSMT in ISO 23704-1,
- Reference architecture of a CPSMT for subtractive manufacturing in ISO 23704-2, and
- Reference architecture of a CPSMT for additive manufacturing in ISO 23704-3²⁾.

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

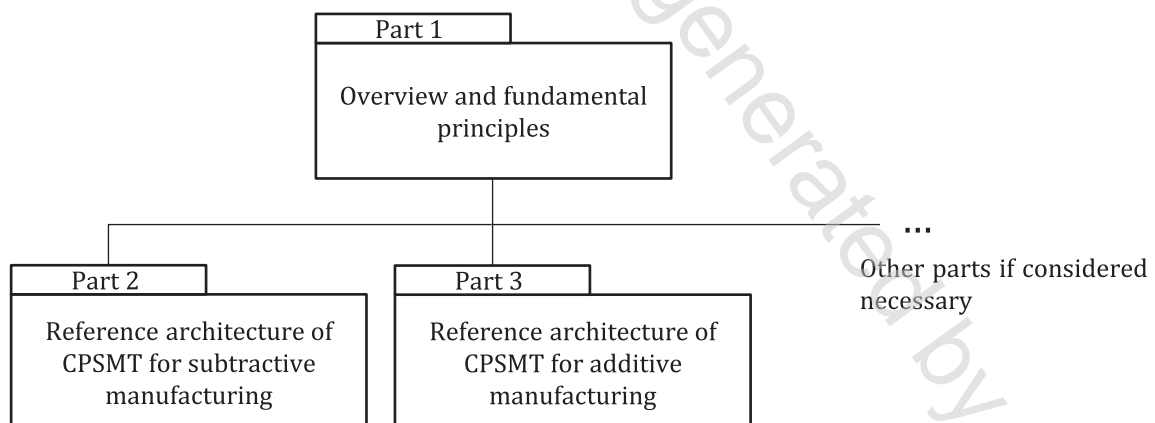


Figure 1 — Overall structure of the ISO 23704 series on general requirements for cyber-physically controlled smart machine tool systems (CPSMT)

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

a) Design engineers in the area of smart machine tools,

- 1) Under development. Stage at the time of publication: IEC/DTR 63319.
- 2) Under development. Stage at the time of publication: ISO/DIS 23704-3.

- b) System architects in the area of smart machine tools,
- c) Software engineers at the MTBs in the area of smart machine tools,
- d) Machine tool control vendors in the area of smart machine tools,
- e) Solution and service providers in the area of smart machine tools, and
- f) End users, such as factory operators working with smart machine tools.

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

Part 1: Overview and fundamental principles

1 Scope

This document specifies the concept and fundamental principles of cyber-physically controlled smart machine tool systems (CPSMT) and requirements, including

- the reference architecture of a CPSMT,
- the key components and interfaces which together make up the reference architecture of a CPSMT, and
- the capabilities of a CPSMT.

This document also provides:

- the background for a CPSMT,
- the concept of a shop floor device system (SFDS), and
- example use cases of the reference architecture of a CPSMT.

This document does not specify physical or implementation architecture.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 Terms and definitions

3.1.1

abnormality

deviation from a standard condition

EXAMPLE Chatter, tool wear above prescribed limits, geometric inaccuracy, energy over-consumption.

[SOURCE: ISO 13372:2012, 4.1, modified — EXAMPLES added.]