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Physical device control — Interfaces for automated machine tending —

Part 2: Safety and control interface

Ensemble de commande pour les équipements — Interfaces pour le chargement automatisé des machines —

Partie 2: Interface de sécurité et de commande

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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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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, *Physical device control*.

A list of all parts in the ISO 21919 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

The ISO 21919 series describes interfaces for automated machine tending of at least one computer numerically controlled (CNC) machine by using a machine tending system. These interfaces are the link between automated machine tending systems and machines used for production. The automated machine tending is initiated by either the machine tending system or by the machine.

ISO 21919-1 gives an overview and defines the fundamental principles on how the interfaces are set up. It defines the necessary vocabulary and sets the syntax for the structure of signals. It distinguishes between the safety interface, the control interface and project specific extensions.

Automated machine tending refers to the automatic loading or unloading of one or more machines by using a machine tending system.

EXAMPLE Examples for machines are machine tools, typically computer numerically controlled (CNC), metrology co-ordinate measuring machines (CMM), 3D structured light scanner (3DSL), and X-ray machines. Examples for machine tending systems are robots, handling systems, gantrys, autonomous intelligent vehicles (AIV), and automated guided vehicles (AGV).

Automated machine tending is a substantial element in highly productive industrial environments. It is a complex endeavour. Necessary devices are complex systems by itself, are oftentimes provided by different suppliers and encounter each other at the production site first time. For a trouble-free collaboration of all units a clear definition of the interfaces is indispensable. For manufacturing systems such standardized interfaces at an international level haven't been defined yet.

Therefore, the definition of the interfaces often is project-specific from the scratch or each supplier tries to establish its in-house standards. These procedures cause great efforts, are prone to failure and hence take a lot of time and manpower. As each interface is built individually and testing beforehand is often not possible, commissioning times exceed the planned ones. Machine builders, system integrators and production plant operators report these issues being substantial obstacles for such automation projects.

Standardized interfaces lead to lean coordination processes, give higher planning reliability, shorten times for commissioning and are less error-prone.

On the other hand, automated machine tending systems can be very complex systems and standards need to be flexible enough to allow an adaption to the requirements of individual projects.

Applications are ranging from simple parts removal to material flow dedicated complex production lines. It is noteworthy that the processing technologies of the machines are independent to the interface and a majority of machine technologies can be integrated with the same standard.

Figure 1 and Figure 2 display the range of complexity of machine tending systems covered by the ISO 21919 series. Figure 1 shows an example of a simple automated machine tending system, consisting of a machine tool loaded by a conveyor.

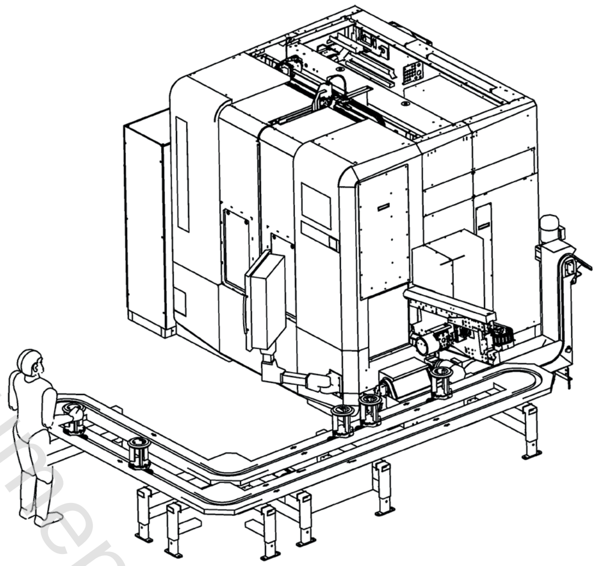

Figure 1 — Example of a simple automated machine tending system

Figure 2 shows an example of a complex production line with five computer numerically controlled machine tools tended by a loading gantry.

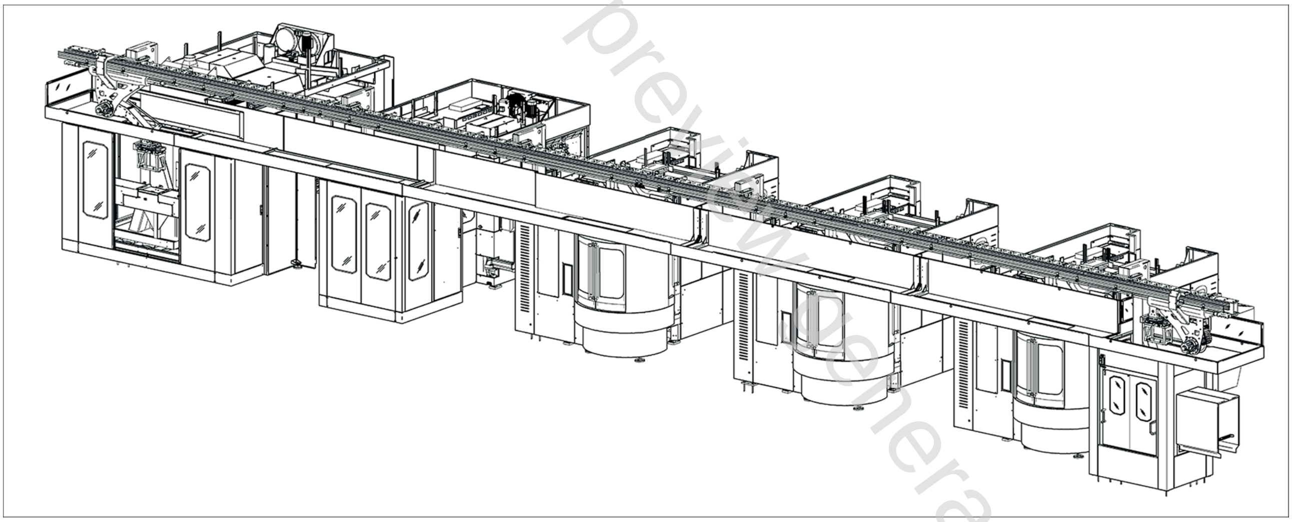

Figure 2 — Example of a complex production line loaded by a gantry

In general, the interfaces for automated machine tending are composed of:

— mechanical;

— control-related; and

— safety-related connections.

Physical device control — Interfaces for automated machine tending —

Part 2: Safety and control interface

1 Scope

This document deals with the safety interface and control interface. It allocates signals to a conformance class and/or conformance option. It describes the detailed functions of each signal, describes and displays the timing interactions between signals in flow charts and shows examples for safety matrices and safety-related functional relationships.

This document defines three conformance classes and dedicated conformance options. Classes and options consist of a number of signals to:

— allow a flexible adaptation of the interface(s) to a project-specific scope of functions and simultaneously;

— tie sets of signals tight enough to avoid unnecessary coordination efforts between suppliers of the machine tending systems and machines.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 21919-1, *Automation systems and integration — Interfaces for automated machine tending — Part 1: Overview and fundamental principles*

IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21919-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
emergency stop
function which is intended to

— avert arising or reduce existing hazards to persons, damage to machinery or to work in progress, and