INTERNATIONAL STANDARD

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Industrial automation systems and integration — Distributed installation in industrial applications —

Part 1: Sensors and actuators

Systèmes d'automatisation industrielle et intégration — Installation distribuée dans les applications industrielles —

Partie 1: Capteurs et organes de commande

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 23570-1 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 1, *Physical device control*.

ISO 23570 consists of the following parts, under the general title *Industrial automation systems and integration — Distributed installation in industrial applications*:

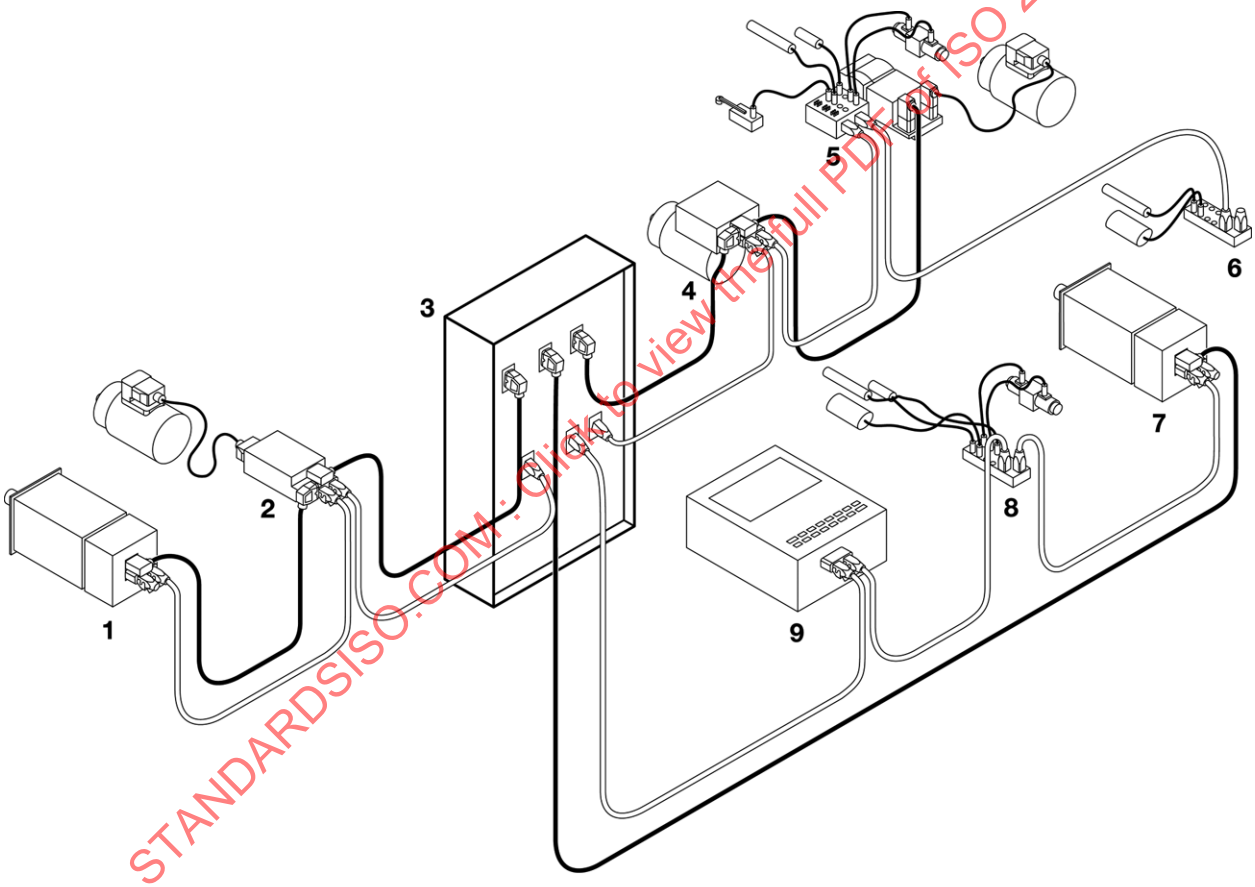
— *Part 1: Sensors and actuators*

— *Part 2: Hybrid communication bus*

— *Part 3: Power distribution bus*

Introduction

Modern machine tools for the discrete parts manufacturing industry are complex systems, consisting of subsystems for material preparation (metal removal, material forming, etc.), material handling, fixturing and transfer lines for moving parts from one station to another. Each subsystem, in turn, is itself a complex system, including many sensors, actuators and control elements that receive and transmit electric signals and/or require electric power. To reduce down time in case of failure, most of them use cable assemblies for quick replacement. Proper operation of the system as a whole requires co-ordination of the subsystems, which requires more cables and connectors. As a consequence of this complexity, a large variety of cables and connectors is required for the proper operation of such a machine tool. The increasing number of sensors, actuators and control elements leads to an increasing variety of such cable assemblies. This variety results in increased maintenance costs, due to complexity, large spare parts inventory and increased training costs for maintenance personnel.



Key

1 motor with integrated electronics (e.g. a stepping motor)
2 fixed speed motor with separate motor controller
3 power distribution and control cabinet
4 fixed speed motor with attached motor controller
5 variable speed motor with integrated I/O module together with sensors and actuators
6 I/O module with a set of sensors
7 motor with integrated electronics (e.g. a stepping motor)
8 I/O module connected to a set of sensors and actuators including a hydraulic/pneumatic valve
9 remote control terminal

Figure 1 — System components addressed in ISO 23570

ISO 23570 prescribes a set of requirements for cables, connectors and parameter selections within these elements, which, if implemented completely, will greatly reduce the wiring complexity and maintenance cost of such machine systems. Benefits will occur to the manufacturer of such systems in the form of decreased complexity costs and to the user of such systems in the form of decreased down time because of decreased parts inventory and simplified maintenance training.

The technology described in ISO 23570 may have applicability to other industries and processes; there is no intention of restricting it to discrete parts manufacturing.

There are three main areas addressed within ISO 23570:

— the interconnection of sensors and actuators to the system backbone;

— a hybrid system backbone containing an information path (a fieldbus) and a source of power to the field devices;

— a power trunk capable of providing power to all the auxiliary motors in the system.

Large power devices, such as spindle motors for metal removal, are not covered by ISO 23570.

Machine tools described in ISO 23570 are subject to constraints imposed by national and international safety standards. It is the intent of ISO 23570 to specify system elements that support the compliance with such standards.

In Figure 1, the solid cable represents the power distribution bus providing three-phase a.c. power for electric motors. The open cable represents a hybrid communication bus, containing both a fieldbus communication channel and low voltage power.

The centre of Figure 1 shows (3) a control cabinet serving three sets of distribution buses. This box contains the fieldbus communication front end, the low voltage power supplies and the three-phase power supplies.

To the left of the control cabinet are (1) a motor with integrated electronics and (2) a fixed speed motor with a separate motor controller. Both units are linked to the control cabinet by both the communication bus and the power distribution bus.

To the right of the control cabinet are (4) a fixed speed motor with an attached motor controller, (5) a variable speed motor with an integrated I/O module connected to several sensors and actuators, and (6) another I/O module connected to several sensors and actuators, including a hydraulic/pneumatic valve. The I/O module (6) is linked to the control cabinet only by the hybrid communication bus.

In front of the control cabinet are three more units, (7) a motor with integrated electronics, (8) another I/O module connected to several sensors and actuators including a hydraulic/pneumatic valve, and (9) a remote control terminal.

Figure 1 is intended to illustrate the variety of interconnections possible using the elements of ISO 23570.

This part of ISO 23570 provides the requirements for sensors, actuators and I/O modules that support this system requirement. ISO 23570-2 provides the requirements for a shared communication and low voltage power distribution system. ISO 23570-3 provides the requirements for distribution of power to the low power motor systems.

While significant reduction in maintenance and operational costs may be achieved by adoption of individual parts of ISO 23570, the greatest benefit will occur only if all parts are implemented.

This part of ISO 23570 provides the requirements for sensors, actuators and I/O modules that support this system requirement.

Industrial automation systems and integration — Distributed installation in industrial applications —

Part 1:
Sensors and actuators

1 Scope

This part of ISO 23570 specifies the interconnection of elements in the control system of machine tools and similar large pieces of industrial automation. This specification includes cable types, sizes and sheath colours, connector types and contact assignments, and diagnostic functions appropriate to the sensors and actuators.

This part of ISO 23570 specifies the interconnection of sensors and actuators with I/O modules that use their input or direct their output, and the diagnostic functions appropriate to those sensors and actuators.

This part of ISO 23570 does not address operation of such equipment with respect to safety issues. Appropriate safety standards should be consulted for such requirements.

2 Conformance

Producers of sensors, actuators, cable assemblies and I/O modules may claim conformance to this part of ISO 23570 if they meet the requirements of Clause 5.

Producers of discrete part manufacturing equipment may claim conformance to this part of ISO 23570 if all the components of the discrete part manufacturing equipment that are subject to the requirements of Clause 5 meet those requirements.

3 Normative references

The following referenced documents are indispensable for the application 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 23570-2:2005, *Industrial automation systems and integration — Distributed installation in industrial applications — Hybrid communication bus*

IEC 60529:2001 Ed. 2.1, *Degrees of protection provided by enclosures (IP code)*

IEC 61076-2-101:2004, *Connectors for electronic equipment — Part 2-101: Circular connectors — Detail specification for circular connectors M8 with screw- or snap-locking, M12 with screw-locking for low voltage applications*

4 Terms and definitions

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

4.1
IP Code
coding system for indicating the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection

[IEC 60529]

4.2
M12
connector meeting the requirements of IEC 61076-2-101, whose diameter is 12 mm

4.3
M12×1
M12 connector with a threaded coupling whose threads have a pitch of 1 mm

5 Requirements

5.1 General

All components specified by this part of ISO 23570 shall be rated IP65 and IP67 as defined in IEC 60529.

Reference is made within this part of ISO 23570 to 24 Vdc power supplies. Requirements for these power supplies can be found in 5.5 of ISO 23570-2:2005.

5.2 Connectors

All connectors between sensors and actuators and the corresponding system elements shall be M12×1 5 contact connectors as specified in IEC 61076-2-101. Because the 5th contact is not used by systems conforming to this part of ISO 23570, it is possible to use a 4 contact M12 connector for male connectors. However, all female connectors shall be 5 contact.

5.3 Cable assemblies

Sensor/actuator cables shall have four wires, each 0,34 mm^2 in section. Each end of a cable assembly shall be terminated in an M12×1 connector, as specified in 5.2, one male and one female. The connectors may be either straight through or right angle connectors. Only styles LM, LF, MM,and MF described in Table 2 of IEC 61076-2-101:2004 are permitted.

The supplier of cable assemblies shall provide a list of lubricants and coolants that are compatible with the cable.

Cable assemblies shall be fabricated in the following standard lengths: 0,3 m, 0,6 m, 1,0 m, 1,6 m and 2,0 m. Other lengths of cable assembly are optional.

Cable assemblies shall not contain any status indicators, such as LEDs.

If the cable is shielded, the sheath colour shall be green; if unshielded, it shall be yellow. See Annex A for a reference to these colours.

All low voltage control cables that are not otherwise specified in this part of ISO 23570 shall have a sheath colour of grey.

5.4 Sensors

5.4.1 General

Sensors shall be fitted with an M12×1 connector as specified in 5.2. The connector shall be male and of the style B, D, E, F, G or H as specified in Table 1 of IEC 61076-2-101:2004.

5.4.2 Analogue sensors

Contact assignments for the connector on the sensor shall be as specified in Table 1.

Table 1 — Contact assignments for analogue sensors

Contact	Assignment
Contact 1	Supply voltage + 24 Vdc
Contact 2	Output of the analogue sensor 4-20 mA
Contact 3	Supply voltage 0 V
Contact 4	Digital signal whose use is reserved for later specification
Contact 5	Not used

5.4.3 Digital sensors

Contact assignments for the connector on the sensor shall be as specified in Table 2.

The sensor shall contain a yellow LED indicator showing the sensor output.

Table 2 — Contact assignments for digital sensors

Contact	Assignment
Contact 1	Supply voltage + 24 Vdc
Contact 2	Diagnostic signal – see text
Contact 3	Supply voltage 0 V
Contact 4	Output of the digital sensor – see text
Contact 5	Not used

The sensor shall provide diagnostic information on contact 2. Normal operation of the sensor shall be indicated by contact 2 being at + 24 Vdc. The indication of abnormal operation is left for later specification.

Some digital sensors may use contact 2 as a second digital output signal instead of a diagnostic signal.

The output of the digital sensor shall be either a switch closure (0 Ω) or a voltage level (nominal 24 Vdc).

5.5 Actuators

5.5.1 General

Actuators shall be fitted with an M12×1 connector as specified in 5.2. The connector shall be male and of the style B, D, E, F, G or H as specified in Table 1 of IEC 61076-2-101:2004.

5.5.2 Analogue actuators

Contact assignments for the connector on the actuator shall be as specified in Table 3.

Table 3 — Contact assignments for analogue actuators

Contact	Assignment
Contact 1	Supply voltage + 24 Vdc
Contact 2	Input to the analogue actuator 4-20 mA
Contact 3	Supply voltage 0 V
Contact 4	Digital signal whose use is reserved for later specification
Contact 5	Not used

5.5.3 Digital actuators

Contact assignments for the connector on the actuator shall be as specified in Table 4.

The actuator shall contain a yellow LED indicator showing the actuator status.

Table 4 — Contact assignments for digital actuators

Contact	Assignment
Contact 1	Supply voltage + 24 Vdc
Contact 2	Diagnostic signal – see text
Contact 3	Supply voltage 0 V
Contact 4	Input to the digital actuator
Contact 5	Not used

The actuator shall provide diagnostic information on contact 2. Normal operation of the actuator shall be indicated by contact 2 being at + 24 Vdc. The indication of abnormal operation is left for later specification.

Suitable suppression shall be included in the actuator to prevent negative voltages less than − 50 V appearing on contact 4.

5.6 I/O modules

The I/O module is the main control element with respect to the sensors and actuators. It provides the output that drives the actuators, and reads the sensors for their input. The I/O module is supplied with 24 Vdc power, which it supplies to the sensors and actuators.

The I/O module shall provide an M12×1 connector for each sensor and actuator that is connected to the module. The connectors shall meet the requirements of 5.2. The connectors shall be female and of the style B, D, E, F, G or H as specified in Table 1 of IEC 61076-2-101:2004. The input or output signals (contacts 2 and 4) shall be interfaced to a solid state circuit, i.e., not to a relay contact.

NOTE 1 Numbering of sensor/actuator channels and further requirements on the I/O modules are addressed in ISO 23570-2.

The I/O module shall contain two indicators for each channel connected to the module as specified in Table 5. The first indicator shall be a yellow LED; the second a bi-coloured LED, yellow and red.

Table 5 — I/O channel indicators

Indicator LED	Signal	Analogue device	Digital device
Contact 4	Yellow	Optional digital signal actuated	Actuated
	Dark	Not actuated	Not actuated
Contact 2	Yellow	Current between 4 mA and 20 mA	Actuated if configured as secondary input
	Red	Current out of bounds	Diagnostic problem if configured as diagnostic input
	Dark	No meaning	Input or diagnostic not activated

NOTE 2 The contact 2 indicator may be implemented as two separate LEDs, one yellow, one red, but only one of these indicators may be lit at any given time.