INTERNATIONAL STANDARD

ISO 14649-14

First edition
2013-03-01

Automation systems and integration — Physical device control — Data model for computerized numerical controllers —

Part 14: Process data for sink electrical discharge machining (sink-EDM)

Systèmes d'automatisation et intégration — Commande des dispositifs physiques — Modèle de données pour les contrôleurs numériques informatisés —

Partie 14: Données de procédé pour l'usinage de baisse électrique (baisse EDM)

Reference number
ISO 14649-14:2013(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 1, *Physical device control*.

ISO 14649 consists of the following parts, under the general title *Automation systems and integration — Physical device control — Data model for computerized numerical controllers*:

— *Part 1: Overview and fundamental principles*

— *Part 10: General process data*

— *Part 11: Process data for milling*

— *Part 12: Process data for turning*

— *Part 13: Process data for wire electrical discharge machining (wire-EDM)*

— *Part 14: Process data for sink electrical discharge machining (sink-EDM)*

— *Part 111: Tools for milling machines*

— *Part 121: Tools for turning machines*

— *Part 201: Machine tool data for cutting processes* [Technical Specification]

Gaps in numbering were intentionally left in order to allow further additions. ISO 14649-10 is the ISO 10303 Application Reference Model (ARM) for process-independent data. ISO 10303 ARMs for specific technologies are added after ISO 14649-10. ISO 14649 is harmonized with ISO 10303 in the common field of Product Data over the whole life cycle. ISO 14649-1 describes the different fields of standardization between ISO 14649, ISO 10303 and CNC manufacturers with respect to implementation and software development.

Introduction

ISO 14649-10 describes the general process data for numerical controlled machining and includes its schema. The subject of this schema (called machining_schema) is the definition of data types, which are generally relevant for different technologies (e.g. milling, turning, sink-EDM). It includes the definition of the workpiece, a feature catalogue containing features, which might be referenced by several technologies, the general executables and the basis for an operation definition. Not included in this schema are geometric items and presentations, which are referenced from the generic resources of ISO 10303, and the technology-specific definitions, which are defined in separate parts of ISO 14649.

ISO 14649-10 is not a stand-alone standard. Its implementation needs at least one additional technology-specific part (e.g. ISO 14649-11 for milling). This part of ISO 14649 describes sink Electrical Discharging Machining (sink-EDM) and it defines technology-specific data types representing the machining process for sink-EDM.

The main text of this part of ISO 14649 provides definitions and explanations of the data entities needed to provide control data information to an EDM controller.

The EXPRESS forms of the entities are given again in Annex A without the explanatory text for information.

Annex B provides an alternative view of these entities, with the different figures showing graphical representations of different elements. These figures are purely informative: a detailed explanation of the entities in the figures is given in the corresponding text definitions.

In addition, the schema uses machining features similar to ISO 10303-224. The description of process data is carried out using EXPRESS language as defined in ISO 10303-11. The encoding of the data is carried out using ISO 10303-21.

Automation systems and integration — Physical device control — Data model for computerized numerical controllers —

Part 14: Process data for sink electrical discharge machining (sink-EDM)

1 Scope

This part of ISO 14649 specifies the technology-specific data element needed as process data for sink-EDM. Together with the general process data described in ISO 14649-10, it describes the interface between computerized numerical controller and the programming system (i.e. CAM system or shop-floor programming system) for sink-EDM. It can be used for sink-EDM operations on this kind of machine.

The scope of this part of ISO 14649 does not include tools for any other technologies (e.g. turning, grinding). Tools for these technologies are described in other parts of ISO 14649.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14649-10, *Industrial automation systems and integration — Physical device control — Data model for computerized numerical controllers — Part 10: General process data*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14649-10 and the following apply.

3.1
roughing
machining operation used to cut a part

Note 1 to entry: While the aim of roughing is to remove large quantities of material in a short time, the surface quality is usually not important.

Note 2 to entry: The roughing operation is usually followed by the *finishing* (3.2) operation.

3.2
finishing
machining operation whose aim is to reach the tolerance of the feature required

Note 1 to entry: The finishing operation is usually preceded by the *roughing* (3.1) operation and followed by the *surface finishing* (3.3) operation.

3.3
surface finishing
machining operation whose aim is to reach the required surface quality

Note 1 to entry: The surface finishing operation is usually preceded by the *finishing* (3.3) operation.

4 Process data for sink-EDM

4.1 Header and references

The following listing gives the header and the list of entities which are referenced within this schema.

```
SCHEMA sink_edm_schema;
(*
Version 3 of Jan 13, 2002
Author: Gabor Erdos
Your email contact: Gabor Erdos <gabor.erdos@epfl.ch>
*)
REFERENCE FROM machining_schema (*ISO 14649-10*)
(
length_measure,
bounding_geometry_select,
machine_functions,
machining_operation,
machining_tool,
material,
property_parameter,
technology,
toleranced_length_measure,
machining_feature,
plane_angle_measure,
axis1_placement,
machining_strategy,
bounded_curve,
rot_speed_measure,
pressure_measure,
advanced_brep_shape_representation,
direction,
rot_direction,
radial_direction,
toolpath,
toolpath_type,
toolpath_speedprofile,
toolpath_list
);
```


4.2 Manufacturing features for sink-EDM

4.2.1 General

The sink-EDM features defined in this subclause are the features that are specific for sink-EDM technology, and are not defined in ISO 14649-10. The base class for all sink-EDM features is the machining_feature, defined in ISO 14649-10.

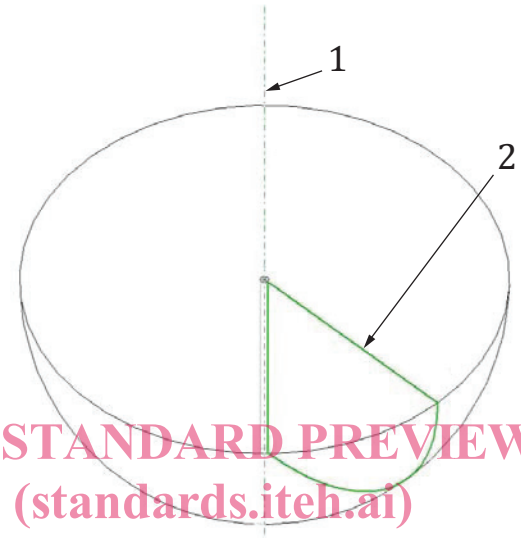
4.2.2 Sink-EDM volumetric pocket

The sink_edm_volumetric_pocket describes a special sink-EDM cavity feature. This feature is created by orbiting the reference point of the tool axis within closed volume. The final shape of the pocket is defined by the outline shape of the tool. The closed volume is defined as a revolved feature, where the feature_boundary curve is revolved around the axis.

```
ENTITY sink_edm_volumetric_pocket
SUBTYPE OF (machining_feature);
feature_boundary: bounded_curve;
axis: axis1_placement;
END_ENTITY;
```

feature_boundary: Defines the cross section of the revolved feature. The feature_boundary lies within the features xz-plane (see Figure 1)IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</Tbl_no_borders>” “” </Tbl_no_borders>

axis: Specifies the axis of the revolving operation. The axis lies within the features xz-plane (see Figure 1)



Key

1	axis
2	feature_boundary

Figure 1 — Sink_edm_volumtric_pocket

4.3 Machining operation for sink-EDM

4.3.1 General

This subclause introduces all the machining operations and technology-specific data that are needed for sink-EDM.

4.3.2 Sink-EDM machining operation

The sink_edm_machining_operation classes define the machining process for a limited area of the workpiece, i.e. the contents of a machining workingstep. This entity is inherited by the machining_workingstep class defined in ISO 14649-10. This class defines additional information needed by the sink-EDM machining. It is a subtype of entity machining_operation defined in ISO 14649-10.

```
ENTITY sink_edm_machining_operation
SUBTYPE OF (machining_operation);
first_depth: OPTIONAL length_measure;
depth_of_step: OPTIONAL length_measure;
approach: OPTIONAL approach_retract_strategy;
retract: OPTIONAL approach_retract_strategy;
END_ENTITY;
```

first_depth: If it is defined the sinking is done in multi-step and this define the depth of the first step.IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</Tbl_no_borders>” “” </Tbl_no_borders>

depth_of_step: Depth of each additional step (repeated until the depth of the hole is reached).

approach: Optional information about approach (plunge) strategy to reach the first cut. If multiple layers are cut, as specified by first_depth, this strategy will also be used to move from one layer to the start point of the next layer. By default, the NC controller decides about the approach strategy. It may decide not to use any approach movement at all if the start point of cutting coincides with the end point of cutting for the preceding operation. If its_toolpath is given, this attribute will be ignored.

retract: Optional information about retract strategy after finishing the last cut. By default, the NC controller decides about the retract strategy. It may decide not to use any retract movement at all if the end point of cutting coincides with the start point of cutting for the next operation. If its_toolpath is given, this attribute will be ignored.

4.3.3 Sink-EDM technology

This entity defines the technological parameters of the sink-EDM operation. It is a subtype of entity technology defined in ISO 14649-10. Since the number of technology parameters are machine dependent, the technology contains only a list that can contain any number of property parameters.


```
ENTITY sink_edm_technology
SUBTYPE OF (technology);
spindle: OPTIONAL rot_speed_measure;
sync_spindle_and_z_feed: BOOLEAN;
other_generator_parameters: SET [0:?] OF property_parameter;
END_ENTITY;
```


spindle: Rotational speed of the tool. As defined for rot_speed_measure, positive values indicate tool rotation in mathematical positive direction of the c axis, i.e. counter-clockwise motion if looking from the tool holder to the workpiece. Note that usual cutting tools require clockwise motion so the value of this attribute will typically be negative.IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</Tbl_no_borders>” “” </Tbl_no_borders>

sync_spindle_and_z_feed: If true, the feed rate in z and spindle speed are synchronized. It is used together with the synchronized_feed strategy.

other_generator_parameters: Set of other parameters of the generator of generic type.

4.3.4 Sink-EDM machining functions

The entity describes the state of various functions of the machine (e.g. coolant) to be applied during the time span of an operation. It is a subtype of entity machine_functions defined in ISO 14649-10.

```
ENTITY sink_edm_machine_functions
SUBTYPE OF (machine_functions);
flush: BOOLEAN;
aspiration: BOOLEAN;
flush_pressure: OPTIONAL pressure_measure;
other_functions: SET [0:?] OF property_parameter;
END_ENTITY;
```


flush: If true, the flush is activated to clean the “chips” and debris from the spark gap. IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</ Tbl_no_borders>” “” </Tbl_no_borders>

aspiration: If true, the aspiration is activated to clean the “chips” and debris from the spark gap.

flush_pressure: Optional specification of the pressure of the dielectric fluid.

other_functions: Optional list of other functions of generic type.

4.3.5 Sink-EDM machining strategy

4.3.5.1 General

The sink_edm_machining_strategy class specifies the strategy to be used when executing the operation. When it is specified it will modify the final offset toolpath generation method. It is a subtype of entity machining_strategy defined in ISO 14649-10.

```
ENTITY sink_edm_machining_strategy
ABSTRACT SUPERTYPE OF (ONEOF (contour_parallel,along_vector,synchronized_feed))
SUBTYPE OF(machining_strategy);
END_ENTITY;
```

4.3.5.2 Contour parallel machining

Sinking in several paths following the contour of the feature. Similar to the contour parallel milling strategy defined in ISO 14649-11 (see Figure 2).

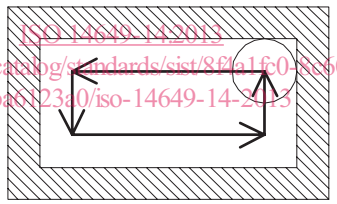


Figure 2 — Contour parallel machining

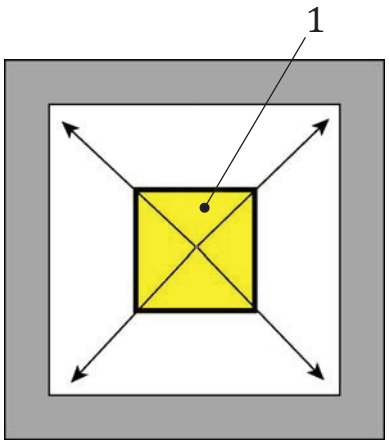
```
ENTITY contour_parallel
SUBTYPE OF(sink_edm_machining_strategy);
rotation_direction: OPTIONAL rot_direction;
stepover_direction: OPTIONAL radial_direction;
END_ENTITY;
```

rotation_direction: The direction of the spiral path (clockwise or counterclockwise) as seen from the top of the feature. The default is counterclockwise. The attribute cutmode, if given, takes precedence over this attribute.IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</Tbl_no_borders>” “” </ Tbl_no_borders>

stepover_direction: If this attribute is outside_in, sink-EDM will start at the outer contour and proceed towards the centre. This is the default. Otherwise, it will start at the centre and proceed towards the outer contour.

4.3.5.3 Along vector machining

Sinking along the direction of the specified vector. Typical strategy to enlarge pockets by moving the sink tool along the specified vectors (see Figure 3).



Key

1 tool

Figure 3 — Along vector strategy

```
ENTITY along_vector
SUBTYPE OF(sink_edm_machining_strategy);
corner_vectors: LIST [0:?] OF direction;
END_ENTITY;
```

corner_vectors: Defines the direction for the tool movement. The start point is defined by the cut_start_point attribute of the machining_operation entity.IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</Tbl_no_borders>” “” </Tbl_no_borders>

4.3.5.4 Synchronized feed

The synchronized feed strategy specifies how the sink tool is rotated as it is plunged into the material. The axis rotation amount is defined as the rotation around the z-axis of the feature coordinate system. The angle is calculated from the x-axis of the same coordinate system.

```
ENTITY synchronized_feed
SUBTYPE OF(sink_edm_machining_strategy);
spindle_rotation_amount: plane_angle_measure;
END_ENTITY;
```

spindle_rotation_amount: Defines the amount of rotation of the tool axis.IF “x_+3” “<Tbl_no_borders>” “”<Tbl_no_borders> IF “x_+3” “<Tbl_no_borders>” “” <Tbl_no_borders>IF “x_-3” “</Tbl_no_borders>” “”</Tbl_no_borders> IF “x_-3” “</Tbl_no_borders>” “” </Tbl_no_borders>

4.3.6 Sink-EDM tool

This class describe the properties of the tool used in sink-EDM machining. It is a subtype of entity machining_tool defined in ISO 14649-10.

```
ENTITY sink_edm_tool
SUBTYPE OF (machining_tool);
coolant_through_tool: OPTIONAL BOOLEAN;
pilot_length: OPTIONAL length_measure;
its_geometry: OPTIONAL advanced_brep_shape_representation;
its_bounding_geometry: OPTIONAL bounding_geometry_select;
its_material: OPTIONAL material;
other_parameters: SET [0:?] OF property_parameter;
END_ENTITY;
```

