
**Industrial automation systems and
integration — Product data
representation and exchange —**

Part 111:
**Integrated application resource: Elements
for the procedural modelling of solid
shapes**

*Systèmes d'automatisation industrielle et intégration — Représentation
et échange de données de produits —*

*Partie 111: Ressources d'application intégrée: Éléments pour la
modélisation procédurale des formes solides*



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Contents

Page

1	Scope	1
2	Normative references	2
3	Terms, definitions and abbreviations	2
3.1	Terms defined in ISO 10303-1	2
3.2	Terms defined in ISO 10303-11	3
3.3	Terms defined in ISO 10303-42	3
3.4	Terms defined in ISO 10303-43	3
3.5	Terms defined in ISO 10303-55	4
3.6	Terms defined in ISO 10303-108	4
3.7	Other terms and definitions	4
3.8	Abbreviations	4
4	Solid shape element	5
4.1	Introduction	5
4.2	Fundamental concepts and assumptions	6
4.3	Solid shape element type definitions	7
4.3.1	base_solid_select	7
4.3.2	blend_end_condition_select	8
4.3.3	generalized_surface_select	8
4.3.4	trim_condition_select	9
4.3.5	blend_radius_variation_type	9
4.3.6	trim_intent	9
4.4	Solid shape element entity definitions	10
4.4.1	modified_solid	10
4.4.2	edge_blended_solid	11
4.4.3	track_blended_solid	12
4.4.4	track_blended_solid_with_end_conditions	13
4.4.5	solid_with_constant_radius_edge_blend	15
4.4.6	solid_with_variable_radius_edge_blend	17
4.4.7	solid_with_chamfered_edges	20
4.4.8	solid_with_single_offset_chamfer	21
4.4.9	solid_with_double_offset_chamfer	21
4.4.10	solid_with_angle_based_chamfer	22
4.4.11	surfaced_open_shell	24
4.4.12	sculptured_solid	25
4.4.13	sculptured_solid_with_selection	26
4.4.14	offset_face_solid	27
4.4.15	shelled_solid	28
4.4.16	double_offset_shelled_solid	30
4.4.17	complex_shelled_solid	31
4.4.18	modified_solid_with_placed_configuration	31
4.4.19	solid_with_depression	32
4.4.20	solid_with_through_depression	33
4.4.21	solid_with_hole	34
4.4.22	solid_with_stepped_round_hole	34
4.4.23	conical_stepped_hole_transition	35
4.4.24	solid_with_stepped_round_hole_and_conical_transitions	37

4.4.25	solid_with_flat_bottom_round_hole	38
4.4.26	solid_with_spherical_bottom_round_hole	39
4.4.27	solid_with_conical_bottom_round_hole	40
4.4.28	solid_with_pocket	41
4.4.29	solid_with_rectangular_pocket	42
4.4.30	solid_with_circular_pocket	44
4.4.31	solid_with_general_pocket	45
4.4.32	solid_with_slot	46
4.4.33	solid_with_straight_slot	47
4.4.34	solid_with_curved_slot	49
4.4.35	solid_with_trapezoidal_section_slot	49
4.4.36	solid_with_tee_section_slot	50
4.4.37	solid_with_groove	52
4.4.38	solid_with_protrusion	54
4.4.39	solid_with_circular_protrusion	54
4.4.40	solid_with_rectangular_protrusion	55
4.4.41	solid_with_general_protrusion	56
4.4.42	solid_with_shape_element_pattern	56
4.4.43	solid_with_circular_pattern	57
4.4.44	solid_with_rectangular_pattern	59
4.4.45	solid_with_incomplete_circular_pattern	60
4.4.46	solid_with_incomplete_rectangular_pattern	61
4.4.47	thickened_face_solid	62
4.4.48	extruded_face_solid_with_trim_conditions	64
4.4.49	extruded_face_solid_with_draft_angle	67
4.4.50	extruded_face_solid_with_multiple_draft_angles	67
4.4.51	revolved_face_solid_with_trim_conditions	68
4.4.52	auxiliary_geometric_instance_aggregator	70
4.5	Solid shape element function definitions	71
4.5.1	check_continuous_edges	71
4.5.2	compute_total_depth	72
4.5.3	validate_countersink_radii	73
Annex A (normative)	Short names of entities	75
Annex B (normative)	Information object registration	77
B.1	Document identification	77
B.2	Schema identification	77
Annex C (informative)	Computer interpretable listings	78
Annex D (informative)	EXPRESS-G diagrams	79
Annex E (informative)	Justification of the modelling approaches taken in this part of ISO 10303	91
E.1	Representation of constructional operations	91
E.2	Representation of local shape configurations	92
Bibliography	93
Index	94

Figures

Figure 1	Schema level diagram of relationships between the solid_shape_element_schema of this part of ISO 10303 and other resource schemas	viii
Figure 2	L-section block	16
Figure 3	L-section block of Figure 2 with constant radius edge blend	16
Figure 4	A track blended solid with a constant radius edge blend	17
Figure 5	L-section block of Figure 2 with variable radius edge blend	19
Figure 6	A track blended solid with end conditions for which the blend radius is variable	19
Figure 7	Solid with double offset chamfer	22
Figure 8	Solid with angle based chamfer	24
Figure 9	Solid and generalized surface defining a sculptured solid	26
Figure 10	The sculptured solid after the partitioning operation	26
Figure 11	Offset face solid	28
Figure 12	Shelled solid	30
Figure 13	Cross-section of solid with stepped round hole	36
Figure 14	Cross-section of solid with stepped round hole and conical transitions	38
Figure 15	Bottom conditions for blind round holes	41
Figure 16	Solid with rectangular pocket	44
Figure 17	Solid with straight slot having two closed ends	48
Figure 18	Straight slot with multiple entries and exits from part material	48
Figure 19	Trapezoidal and T slot sections	51
Figure 20	Solid with groove	53
Figure 21	The effect of radial alignment in solid_with_circular_pattern	58
Figure 22	Solid with rectangular pattern	60
Figure 23	Solid with incomplete circular pattern	61
Figure 24	Solid with incomplete rectangular pattern	62
Figure 25	Thickened face solid	63
Figure 26	Extruded face solid with draft angle	66
Figure D.1	solid_shape_element_schema – EXPRESS-G diagram 1 of 11	80
Figure D.2	solid_shape_element_schema – EXPRESS-G diagram 2 of 11	81
Figure D.3	solid_shape_element_schema – EXPRESS-G diagram 3 of 11	82
Figure D.4	solid_shape_element_schema – EXPRESS-G diagram 4 of 11	83
Figure D.5	solid_shape_element_schema – EXPRESS-G diagram 5 of 11	84
Figure D.6	solid_shape_element_schema – EXPRESS-G diagram 6 of 11	85
Figure D.7	solid_shape_element_schema – EXPRESS-G diagram 7 of 11	86
Figure D.8	solid_shape_element_schema – EXPRESS-G diagram 8 of 11	87
Figure D.9	solid_shape_element_schema – EXPRESS-G diagram 9 of 11	88
Figure D.10	solid_shape_element_schema – EXPRESS-G diagram 10 of 11	89
Figure D.11	solid_shape_element_schema – EXPRESS-G diagram 11 of 11	90

Tables

A.1	Short names of entities	75
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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.

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 10303-111 was prepared by Technical Committee ISO/TC184/SC4, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

ISO 10303 is organized as a series of parts, each published separately. The structure of ISO 10303 is described in ISO 10303-1.

Each part of ISO 10303 is a member of one of the following series: description methods, implementation methods, conformance testing methodology and framework, integrated generic resources, integrated application resources, application protocols, abstract test suites, application interpreted constructs, and application modules. ISO 10303-111 is a member of the integrated application resources series. The integrated generic resources and the integrated application resources specify a single conceptual product data model.

A complete list of parts of ISO 10303 is available from the following URL:

http://www.tc184-sc4.org/titles/STEP_Titles.htm

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation of product information and for the exchange of product data. The objective is to provide a neutral mechanism capable of describing products throughout their life cycle. This mechanism is suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases, and as a basis for archiving.

This part of ISO 10303 is a member of the integrated resources series. This part of ISO 10303 specifies the **solid_shape_element_schema**.

A set of solid modelling shape elements is defined that provide a capability for the exchange of feature-based CAD solid models, expressed in terms of the sequence of successive creation or modification operations used to build them. This kind of representation of a product shape model is referred to as a *procedural, history-based* or *construction history model*. The essential underlying resource for the representation of models of this type is ISO 10303-55, which provides the mechanism for capturing the sequence of operations, and defines the intended interpretation of the entities defined in this part of ISO 10303 as modelling operations. This part of ISO 10303 contains a single schema, the **solid_shape_element_schema**, which defines a set of complex geometric elements that can be incorporated into a solid shape model. The relationship of this schema to other schemas that define the integrated resources of ISO 10303 is illustrated in Figure 1 using the EXPRESS-G notation. EXPRESS-G is defined in annex D of ISO 10303-11:2004. The schemas occurring in Figure 1 are components of ISO 10303 integrated resources, and they are specified in the following resource parts:

support_resource_schema	ISO 10303-41
measure_schema	ISO 10303-41
geometry_schema	ISO 10303-42
topology_schema	ISO 10303-42
geometric_model_schema	ISO 10303-42
representation_schema	ISO 10303-43
mathematical_functions_schema	ISO 10303-50
explicit_geometric_constraint_schema	ISO 10303-108
sketch_schema	ISO 10303-108

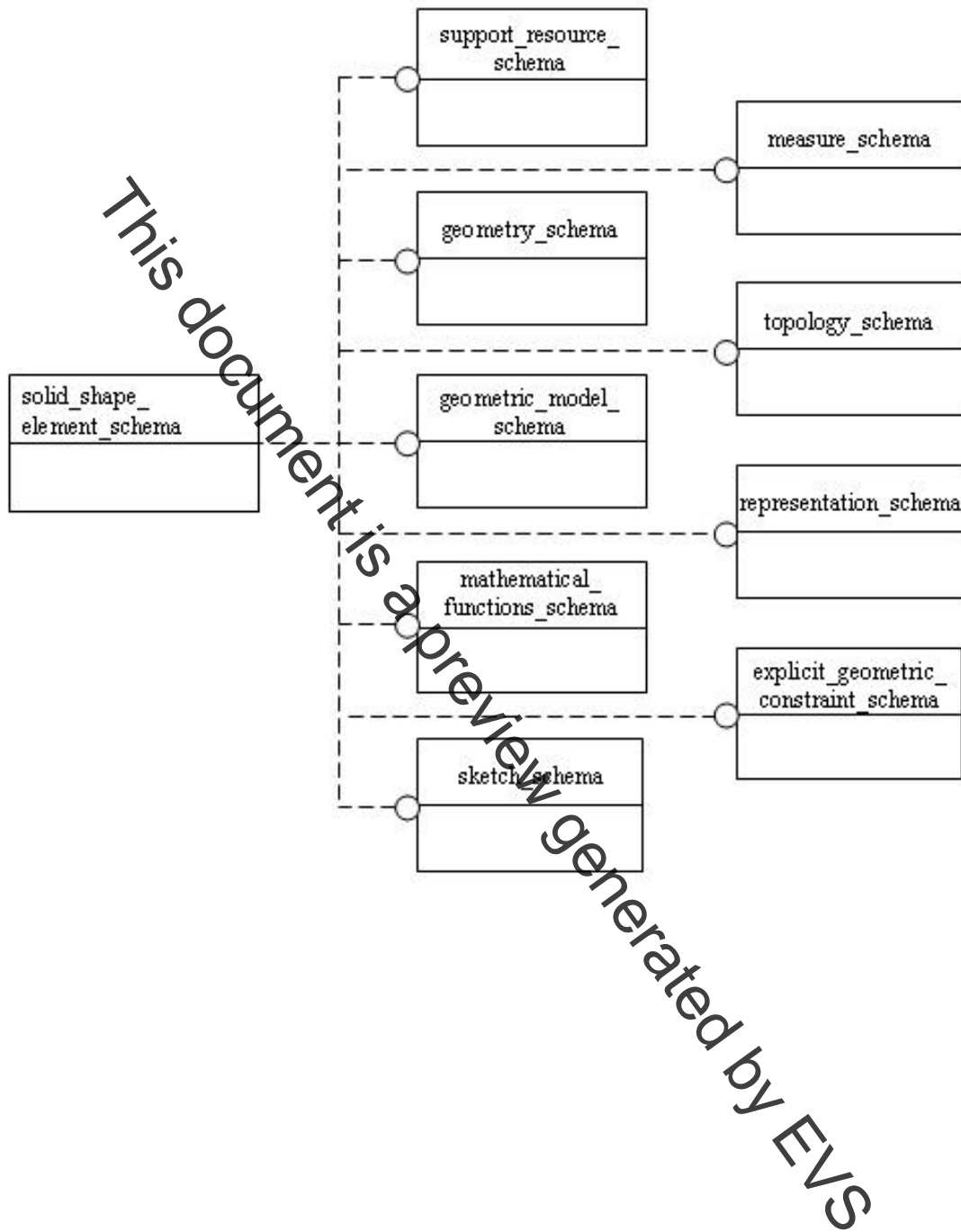


Figure 1 – Schema level diagram of relationships between the solid_shape_element_schema of this part of ISO 10303 and other resource schemas

Industrial automation systems and integration — Product data representation and exchange —

Part 111:

Integrated application resource: Elements for the procedural modelling of solid shapes

1 Scope

This part of ISO 10303 specifies resource constructs for representing the complex shape elements, sometimes known as form features, that are supported by the solid modelling capabilities of modern CAD systems. The elements are defined in such a way as to facilitate the exchange of solid models of products represented in terms of their constructional history.

NOTE 1 Procedural or constructional history models of solids can also include operations based directly on entities defined in ISO 10303-42, in particular Boolean operations and operations based on the various subtypes of **swept_face_solid** and **swept_area_solid**.

The following are within the scope of this part of ISO 10303:

- the representation of solids having shape configurations resulting from blending and chamfering operations;
- the representation of solids with shape configurations resulting from offsetting, thickening, shelling and sculpturing operations;
- the representation of solids having shape configurations characteristic of certain manufacturing features, including several types of holes, pockets, slots and grooves;
- the representation of solids having circular and rectangular patterns of the types of shape configurations mentioned in the previous item of this list;
- the representation of solids that are generalizations of the solids of extrusion and revolution defined in ISO 10303-42.

The following are outside the scope of this part of ISO 10303:

- the representation of shape configurations on a model as *aspects* of the shape of the model, in the sense defined by ISO 10303-41;

NOTE 2 For design purposes the configurations specified in this part of ISO 10303 are regarded as shape elements in their own right, and not as local aspects of more complex shapes. These configurations can be created, subjected to modification and even subsequently deleted during the design process, so that they do not in general appear in their original form as shape aspects of the final model.

- the representation of features relating to manufacturing or other applications downstream of design.

NOTE 3 Such features have associated semantics that are absent from the shape configurations defined in this part of ISO 10303, which are purely concerned with the form of the modelled object.

2 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/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1) - Part 1: Specification of basic notation*

ISO 10303-1, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*

ISO 10303-11:2004, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*

ISO 10303-41, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resource: Fundamentals of product description and support*

ISO 10303-42, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resource: Geometric and topological representation*

ISO 10303-43, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resource: Representation structures*

ISO 10303-50, *Industrial automation systems and integration — Product data representation and exchange — Part 50: Integrated generic resource: Mathematical constructs*

ISO 10303-55:2005, *Industrial automation systems and integration — Product data representation and exchange — Part 55: Integrated generic resource: Procedural and hybrid representation*

ISO 10303-108, *Industrial automation systems and integration — Product data representation and exchange — Part 108: Integrated application resource: Parameterization and constraints for explicit geometric product models*

3 Terms, definitions and abbreviations

3.1 Terms defined in ISO 10303-1

For the purposes of this document, the following terms defined in ISO 10303-1 apply.

- application;
- application context;
- application protocol (AP);
- data exchange;