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

**Part 28:
Implementation methods: XML
representations of EXPRESS schemas
and data**

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

*Partie 28: Méthodes d'implémentation: représentations XML de
schémas et de données EXPRESS*



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Content	Page
Foreword.....	viii
Introduction.....	ix
1 Scope.....	1
2 Normative references.....	2
3 Terms, definitions, and abbreviations.....	3
3.1 Terms defined in ISO 10303-1.....	3
3.2 Other terms and definitions.....	3
3.3 Abbreviations.....	5
3.4 Terminology.....	5
4 Fundamental concepts, assumptions, and limitations.....	6
4.1 Early and late binding.....	6
4.2 Mapping between bindings.....	6
4.2.1 Use of Architectural forms.....	7
4.2.2 Use of XSLT.....	8
4.3 XML markup declaration sets and Document Type Declarations.....	9
4.4 XML names.....	9
4.4.1 Name restrictions in XML.....	9
4.4.2 Use of case in XML element type names.....	9
4.5 Use of ID, IDREF and the reftype XML attribute.....	9
4.6 Character coding limitations.....	10
5 Conformance.....	10
5.1 Conformance of an XML document.....	11
5.1.1 Binding conformance.....	11
5.1.2 Architectural conformance.....	11
5.1.3 XML document representation categories.....	11
5.2 Conformance of an XML document element.....	12
5.3 Conformance of a pre-processor.....	13
5.4 Conformance of a post-processor.....	13
5.5 Conformance of a markup declaration generator.....	13
6 Document level elements.....	13
6.1 The iso_10303_28 element.....	14
6.2 Document header information.....	14
6.2.1 The iso_10303_28_header element.....	14
6.2.2 The document_name element.....	14
6.2.3 The time_stamp element.....	15
6.2.4 The author element.....	15
6.2.5 The originating_organization element.....	15
6.2.6 The authorization element.....	15
6.2.7 The originating_system element.....	16
6.2.8 The preprocessor_version element.....	16
6.2.9 The purpose element.....	16
6.2.10 The documentation element.....	16
6.3 The schema_population element.....	16

6.4	EXPRESS schema descriptive information	18
6.4.1	The <code>express_schema</code> element	18
6.4.2	The <code>schema_text</code> element	19
6.4.3	The <code>schema_decl</code> element	19
6.5	Data descriptive information	19
6.5.1	The <code>express_data</code> element	19
6.5.2	The <code>data_section_header</code> element	20
6.6	Inter-XML document reference information	21
6.6.1	References to remote XML resources	21
6.6.2	Referencing a remote XML element	21
6.6.3	Including components in documents	22
7	Late-bound markup declarations for EXPRESS-defined data	24
7.1	Representation of a schema instance	25
7.2	Representation of an EXPRESS entity instance	26
7.2.1	Representation using the <code>entity_instance</code> element	26
7.2.2	Representation using <code>entity_instance_as_group</code>	27
7.3	Representation of EXPRESS attributes	28
7.3.1	Representation of EXPRESS mandatory explicit attributes	29
7.3.2	Representation of EXPRESS OPTIONAL explicit attributes	30
7.3.3	Representation of EXPRESS INVERSE attributes	30
7.3.4	Representation of DERIVED attributes	30
7.3.5	Representation of redeclared attributes	31
7.3.6	Representation of explicit attributes redeclared as DERIVED	31
7.3.7	Representation of attributes redeclared as INVERSE	31
7.4	Representation of EXPRESS attribute values	31
7.4.1	Representation of primitive data types	32
7.4.2	Representation of aggregate data types	34
7.4.3	Representation of defined data types	37
7.4.4	Representation of EXPRESS attribute values that are EXPRESS entity instance references	39
8	EXPRESS-typed Early Binding (ETEB)	41
8.1	Fundamental concepts and assumptions	41
8.1.1	Preconditions	41
8.1.2	EXPRESS entity referencing	41
8.1.3	Multiple supertypes	42
8.1.4	Unmapped EXPRESS concepts	43
8.1.5	Late binding architectural form	43
8.1.6	Inter-subtype constraints	43
8.2	XML markup declaration set	44
8.2.1	Element naming	44
8.2.2	Schema independent declarations	44
8.2.3	EXPRESS schema declaration	46
8.2.4	Defined data types	48
8.2.5	EXPRESS entity data type declarations	51
8.2.6	EXPRESS explicit attribute declarations	55
8.2.7	Subtypes and supertypes	59
8.2.8	Aggregate data types	63

8.2.9	Interface specifications	66
8.2.10	Constants	69
8.2.11	Derived attributes	70
8.2.12	Declaration set optimizations	70
8.3	Data encoding	70
8.3.1	Representation of EXPRESS entity instances	70
8.3.2	Representation of EXPRESS explicit attributes	71
8.3.3	Representation of DERIVED attributes	71
8.3.4	Representation of EXPRESS attribute values	71
9	Object Serialization Early Binding (OSEB)	74
9.1	Fundamental Concepts and Assumptions	74
9.1.1	Preconditions	74
9.1.2	Unmapped EXPRESS concepts	74
9.2	OSEB element naming	75
9.2.1	Mapping EXPRESS identifiers to XML	75
9.2.2	Names resulting from EXPRESS named data types	75
9.3	EXPRESS schema-independent element types	76
9.3.1	Elements for simple types	76
9.3.2	Elements for aggregate types	78
9.3.3	The unset element	79
9.3.4	The uos element	79
9.3.5	The external identification elements	80
9.3.6	The spath element	80
9.4	XML declarations for EXPRESS named data types	81
9.4.1	EXPRESS ENUMERATION types	81
9.4.2	EXPRESS SELECT types	81
9.4.3	EXPRESS entity data types	82
9.4.4	EXPRESS non-constructed defined data types	86
9.5	XML declarations for EXPRESS attributes	88
9.5.1	Attribute naming	88
9.5.2	Explicit attributes	90
9.5.3	INVERSE attributes	90
9.5.4	DERIVED attributes	91
9.5.5	Redeclared attributes	92
9.6	XML attribute types for EXPRESS attributes	92
9.6.1	NUMBER, REAL, INTEGER attributes	92
9.6.2	BOOLEAN attributes	93
9.6.3	LOGICAL attributes	93
9.6.4	STRING attributes	94
9.6.5	BINARY attributes	94
9.6.6	ENUMERATION-typed attributes	95
9.6.7	SELECT-typed attributes	95
9.6.8	EXPRESS entity instance-valued attributes	96
9.6.9	Attributes with non-constructed defined types	96
9.6.10	Attributes with aggregate data types	97
9.7	Creation of express_data content	99
9.7.1	Unit of serialization	99
9.7.2	Representation of EXPRESS entity instances	105

9.7.3 Representation of the unset element	106
9.8 Representation of EXPRESS attribute values	106
9.8.1 Representation of INTEGER values	106
9.8.2 Representation of REAL and NUMBER values	107
9.8.3 Representation of BOOLEAN values	108
9.8.4 Representation of LOGICAL values	109
9.8.5 Representation of STRING values	110
9.8.6 Representation of BINARY values	111
9.8.7 Representation of ENUMERATION items	111
9.8.8 Representation of EXPRESS entity instances as values of attributes	112
9.8.9 Representation of values of SELECT types	112
9.8.10 Representation of aggregate values	115
9.8.11 Representation of values of non-constructed defined data types	123
10 XML document creation	128
10.1 General XML document structure using binding representation	128
10.2 Representation of EXPRESS schemas	128
10.3 Representation of data	129
10.3.1 Late binding XML documents	129
10.3.2 EXPRESS-typed Early Binding XML documents	130
10.3.3 Object Serialization Early Binding XML documents	132
10.3.4 Mixed representation XML documents	132
10.4 Use of XML Namespaces	133
Annex A (normative) Information object registration	135
Annex B (normative) The XML markup declaration set for late bound data	136
Annex C (normative) Representing EXPRESS schemas	140
Annex D (normative) Base architecture document type definition	168
Annex E (normative) Universal Resource Names for bindings of EXPRESS schemas	169
Annex F (normative) Valid populations of EXPRESS entity instances	170
Annex G (informative) Computer interpretable listings	180
Annex H (informative) Technical Discussions	181
Annex I (informative) Examples	187
Annex J (informative) User Guide to XML Encodings in 10303-28	295
Annex K (informative) Mapping of Object Serialization Early Binding to Late Binding using XSLT301	
Annex L (informative) Mapping of EXPRESS-Typed Early Binding to Late Binding using XSLT 313	
Annex M (informative) Mapping from the EXPRESS Typed Early Binding to the Object Serialization Early Binding	323

Annex N (informative) Mapping from the Late Binding to the Object Serialization Early Binding	334
Bibliography.....	351
Index.....	352

Figures

Figure 1 - Relationship between markup declaration sets.....	7
--	---

Tables

Table J.1 Data encoding size comparison	299
Table J.2 Binding approaches to design issues	300

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 10303-28 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

This International Standard is organized as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. A complete list of parts of ISO 10303 is available from the Internet:

<<http://www.nist.gov/sc4/editing/step/titles/>>.

This part of ISO 10303 is a member of the implementation methods series.

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 specifies means by which schemas specified using the EXPRESS language (ISO 10303-11) and data governed by EXPRESS schemas can be represented as an XML document (Extensible Markup Language W3C Recommendation). Readers of this part of ISO 10303 should have knowledge of the EXPRESS language, XML and XML-related standards in order to understand its technical content.

For the representation of EXPRESS schemas, this part of ISO 10303 specifies an XML markup declaration set based on the syntax of the EXPRESS language. EXPRESS text representation of schemas is also supported.

For the representation of data corresponding to an EXPRESS schema, this part of ISO 10303 takes two broad approaches. One approach is to specify a single markup declaration set that is independent of the EXPRESS schema and can represent data for any schema. This approach is called late binding. The second approach is to specify the results of the generation of a markup declaration set that is dependent on the EXPRESS schema. This approach is called early binding.

This part of ISO 10303 specifies one late binding and two early bindings. Future editions of this part of ISO 10303 are expected to include additional early bindings.

The markup declaration sets in this part of ISO 10303 are intended as formal specifications for the appearance of markup in conforming XML documents. These declarations may appear as part of Document Type Definitions (DTDs) for such documents. Future editions of this part of ISO 10303 are expected to include specifications for the use of XML Schema [3] for this purpose.

EXAMPLE 1 For the following EXPRESS schema:

```
SCHEMA my_schema;
  ENTITY an_entity;
    attr1 : STRING;
  END_ENTITY;
END_SCHEMA;
```

The corresponding XML markup would be:

```
<schema_decl>
  <schema_id>my_schema</schema_id>
  <entity_decl>
    <entity_id>an_entity</entity_id>
    <explicit_attr_block>
      <explicit_attr>
        <attribute_id>attr1</attribute_id>
        <base_type><string/></base_type>
      </explicit_attr>
```

```

    </explicit_attr_block>
  </entity_decl>
</schema_decl>

```

The late binding is a single markup declaration set that can be used to represent data corresponding to any EXPRESS schema. Additionally, the late binding can be used as the base architecture for early bindings as specified by the Architectural Form Definition Requirements in ISO 10744:1997 (HyTime). One such early binding is specified in this part of ISO 10303. That early binding, called the EXPRESS-typed Early Binding, preserves many of the data types defined in EXPRESS schemas.

EXAMPLE 2 For the following EXPRESS schema:

```

SCHEMA my_schema;
  ENTITY an_entity;
    attr1 : STRING;
  END_ENTITY;
END_SCHEMA;

```

a set of late-bound data as XML markup might be:

```

<schema_instance schema_name="my_schema" id="id1">
  <entity_instance express_entity_name="an_entity" id="id2">
    <attribute_instance express_attribute_name="attr1">
      <string_literal>an attr1 value</string_literal>
    </attribute_instance>
  </entity_instance>
</schema_instance>

```

and the same data using the EXPRESS-typed Early Bindings:

```

<My_schema-schema id="id1" schema_name="My_schema"
schema_identifier="My_schema Edition 2">
  <An_entity id="id2">
    <An_entity.attr1><string>an attr1 value</string></An_entity.attr1>
  </An_entity>
</My_schema-schema>

```

Early bindings can also be specified that are not architecturally compatible with the late binding. In this part of ISO 10303, these bindings are related to the late binding through the specification of a means of transforming data represented using that early binding into the same data represented using the late binding. Transformations of this nature are specified that use XSLT (XSL Transformations W3C Recommendation). XSLT is a language for transforming one XML document into another XML document. One such early binding and XSLT transformation generation is specified in this part of ISO 10303. That early binding, called the Object Serialization Early Binding, is based on object serialization patterns for programming languages.

EXAMPLE 3 For the following EXPRESS schema:

```

SCHEMA my_schema;
  ENTITY an_entity;
    attr1 : STRING;
  END_ENTITY;
END_SCHEMA;

```

a set of Object Serialization Early Binding data as XML markup might be:

```
<uos c="id2" schema_name="My_schema" unset="unset">  
  <An_entity x-id="id2" Attr1-r="id3"/>  
  <string x-id="id3">an attr1 value</string>  
</uos>
```

Several components of this part of ISO 10303 are available in electronic form. This access is provided through the specification of Universal Resource Locators (URLs) that identify the location of these files on the Internet. If there is difficulty accessing these files contact the ISO Central Secretariat, or contact the ISO TC 184/SC4 Secretariat directly at: sc4sec@cme.nist.gov.

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Industrial automation systems and integration — Product data representation and exchange — Part 28: Implementation methods: XML representations of EXPRESS schemas and data

1 Scope

This part of ISO 10303 specifies use of the Extensible Markup Language (XML) to represent schemas specified using the EXPRESS data specification language, ISO 10303-11, and data that is governed by EXPRESS schemas.

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

- specification of XML markup declarations that enable EXPRESS schemas to be represented using XML;
- specification of a single XML markup declaration set that is independent of the EXPRESS schema and formally describes the XML representation of data governed by any schema;

NOTE 1 XML markup declarations specified using this method are referred to as late bound, in that they may be used without change to represent data governed by any EXPRESS schema. This part of ISO 10303 allows for a number of choices in representing the data.

- for an arbitrary EXPRESS schema, specification of an XML markup declaration set that corresponds to the schema and formally describes the XML representation of data governed by that schema;

NOTE 2 XML markup declarations specified using these methods are referred to as early bound, in that they are specific to a given EXPRESS schema.

- specification of the mapping between XML markup declarations corresponding to a specific schema and the XML markup declarations independent of any schema;
- specification of the form of XML documents containing EXPRESS schemas and data governed by EXPRESS schemas;
- specification of the representation of EXPRESS primitive data type values as element content and as XML attribute values.

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

- specification of XML markup declarations corresponding to an EXPRESS schema that depend on the semantic intent of the EXPRESS schema;
- specification of mappings from XML markup declarations to an EXPRESS schema;

NOTE 3 Given a set of XML markup declarations and one or more corresponding data sets, it is feasible to create an EXPRESS schema that captures the semantic intent of the data. However, this requires an understanding of the meaning and use of the data that may not be captured by the XML markup declarations.

— specification of the mapping to an EXPRESS schema from an XML representation of that schema;

— specification of the mapping to an EXPRESS schema from XML markup declarations that have been derived from that schema;

— any mapping to or use of XML schema [3].

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 6093:1985, *Information processing — Representation of numerical values in character strings for information interchange*

ISO/IEC 6429:1992, *Information technology — Control functions for coded character sets*

ISO 8601:1988, *Data elements and interchange formats — Information interchange — Representation of dates and times*

ISO/IEC 8824-1:1998, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO 10303-1:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*

ISO 10303-11:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*

ISO 10303-22:1998, *Industrial automation systems and integration — Product data representation and exchange — Part 22: Implementation methods: Standard data access interface*

ISO 10303-23:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 23: Implementation methods: C++ language binding to the standard data access interface*

ISO 10744:1997, *Information technology — Hypermedia/Time-based Structuring Language (HyTime)*

Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies. Internet Engineering Task Force RFC 2045 November 1996 [cited 2000-08-15]. Available from World Wide Web: <<http://www.ietf.org/rfc/rfc2045.txt>>

Uniform Resource Identifiers (URI): Generic Syntax. Internet Engineering Task Force RFC 2396 August 1998 [cited 2000-08-07]. Available from World Wide Web: <<http://www.ietf.org/rfc/rfc2396.txt>>

URN Syntax. Internet Engineering Task Force RFC 2141 May 1997 [cited 2000-09-28]. Available from World Wide Web: <<http://www.ietf.org/rfc/rfc2141.txt>>

Extensible Markup Language (XML) 1.0. World Wide Web Consortium Recommendation 10 February 1998 [cited 2000-04-26]. Available from World Wide Web: <<http://www.w3.org/TR/1998/REC-xml-19980210>>

Namespaces in XML. World Wide Web Consortium Recommendation 14 January 1999 [cited 2000-04-26]. Available from World Wide Web: <<http://www.w3.org/TR/1998/REC-xml-19990114>>

XML Linking Language (XLink) Version 1.0. World Wide Web Consortium Candidate Recommendation 3 July 2000 [cited 2000-08-08]. Available from World Wide Web: <<http://www.w3.org/TR/2000/CR-xlink-20000703>>

XML Transformations (XSLT) Version 1.0. World Wide Web Consortium Recommendation 16 November 1999 [cited 2000-08-07]. Available from World Wide Web: <<http://www.w3.org/TR/1999/REC-xslt-19991116>>

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:

- data;
- information.

3.2 Other terms and definitions

For the purposes of this document, the following terms and definitions apply. Terms defined in the XML 1.0 Recommendation and ISO 10303-11 are repeated below for convenience.

NOTE Definitions copied verbatim from other standards are followed by a reference to the source standard in brackets. Definitions that have been adapted from other standards are followed by an explanatory note.