
**Industrial automation systems and
integration — Integration of life-cycle
data for process plants including oil and
gas production facilities —**

Part 7:

**Implementation methods for the
integration of distributed systems:
Template methodology**

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donnees de cycle de vie pour les industries de «process», y compris les
usines de production de petrole et de gaz —*

*Partie 7: Methodes de mise en œuvre pour l'integration de systemes
distribués: Methodologie de modèle*



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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.

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 every three years with a view to deciding whether it can be transformed into an International Standard.

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 15926-7 was prepared by Technical Committee ISO/TC 184, *Automation systems and integration*, Subcommittee SC 4, *Industrial data*.

ISO 15926 is organized as a series of parts, each published separately. The structure of ISO 15926 is described in ISO 15926-1.

Each part of ISO 15926 is a member of the following series: data model, reference data, implementation methods, conformance testing methodology and framework, characterization methods, abstract test suites. This part of ISO 15926 is a member of the implementation methods series.

A complete list of parts of ISO 15926 is available from the following URL:

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

Introduction

ISO 15926 is an International Standard for the representation of process plant life-cycle information. This representation is specified by a generic, conceptual data model that is suitable as the basis for implementation in a shared database or data warehouse. The data model is designed to be used in conjunction with reference data: standard instances that represent information common to a number of users, process plants, or both. The support for a specific life-cycle activity depends on the use of appropriate reference data in conjunction with the data model.

ISO 15926 is organized as a number of parts, each published separately. This part of ISO 15926 specifies the template methodology and is independent of implementation methodologies and computer languages.

This part of ISO 15926 deals with the template methodology, which defines strict models of ISO 15926-2 conceptual model elements which can be used in data modelling, integration and interoperability methods. This part of ISO 15926 is independent of implementation languages, implementation infrastructure and test methods.

This part of ISO 15926 serves as the basis for implementation languages, implementation infrastructure and test methods.

This part of ISO 15926 addresses:

- the method of first-order logic used;
- template syntax;
- the semantics of templates;
- the method of template expansion;
- the definition of proto templates;
- the initial set of templates.

Readers of this part of ISO 15926 require an understanding of conceptual data models and of ISO 15926-2.

The target audiences for this part of ISO 15926 are as follows:

- technical managers wishing to determine whether ISO 15926 is appropriate for their business needs;
- implementers.

In this part of ISO 15926, the same English language word might be used to refer to a real world thing, to an EXPRESS representation of the real world thing, or to an RDF/XML representation of the real-world thing. These uses are distinguished by the following typographic conventions:

- if a word or phrase occurs in the same typeface as the surrounding narrative text, the word or phrase refers to the real-world thing;
- if the word or phrase occurs in **bold** typeface, it refers to the EXPRESS representation from the ISO 15926-2 data model;

EXAMPLE 1 **class_of_inanimate_physical_object**

- if the word or phrase occurs in **bold camel case** typeface, it refers to a term in the ISO 15926-2 language, as specified in 4.1;

EXAMPLE 2 **ClassOfApprovalByStatus**

- if the word or phrase occurs in *italic camel case* typeface, it refers to a template name.

EXAMPLE 3 *RTriple(z, x, y)*

References to identifiers in examples are fictitious.

In this part of ISO 15926, diagrams are occasionally used to illustrate ISO 15926-2 modelling patterns. The symbols used in instance diagrams are a minor modification of the symbols used in ISO 15926-2.

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Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities —

Part 7: Implementation methods for the integration of distributed systems: Template methodology

1 Scope

This part of ISO 15926 is a specification for data exchange and life-cycle information integration using templates based on the data model of ISO 15926-2. This part of ISO 15926 provides a methodology for data integration of ontologies using mathematical first-order logic, which makes it independent of computer languages.

The following are within the scope of this part of ISO 15926:

- representation of the ISO 15926-2 EXPRESS model in formal logic;
- criteria for template definitions;
- methods of template expansion and verification;
- initial set of template definitions.

NOTE For practical guidelines to information representation using templates, see <http://www.iso.org/iso/iso-15926-7-2011>.

The following are outside the scope of this part of ISO 15926:

- implementation in computer-interpretable languages;
- storage and retrieval;
- security.

2 Terms, definitions, and abbreviated terms

2.1 Terms and definitions

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

2.1.1

base template

template with only entity types in the expansion of its template axiom

2.1.2

class

category or division of things based on one or more criteria for inclusion and exclusion

NOTE 1 A class need not have any known members (things that satisfy its criteria for membership).

NOTE 2 Because of the spatio-temporal paradigm used to define individuals in ISO 15926, all classes are non-well-founded sets.

NOTE 3 Adapted from ISO 15926-1:2004, definition 3.1.1.

2.1.3

class template

template for making statements about classes

2.1.4

conceptual data model

data model in the threg/schema architecture defined by ISO/TR 9007, in which the structure of data is represented in a form independent of any physical storage or external presentation format

2.1.5

core class

class that is a commonly used subdivision corresponding to terms used in common language

NOTE The conditions for membership are often not formally defined; understanding of the class may be conveyed by example.

EXAMPLE Pipe, floor, pump, and light bulb are all core classes.

[ISO 15926-1:2004, definition 3.1.4]

2.1.6

core template

RDL template for which all reference data items in the expansion of its template axiom are core classes

2.1.7

data store

computer system that allows data to be stored for future reference

[ISO 15926-1:2004, definition 3.1.6]

2.1.8

data type

domain of values

[ISO 10303-11:2004, definition 3.3.5]

2.1.9

data warehouse

data store in which related data are merged to provide an integrated set of data containing no duplication or redundancy of information, and which supports many different application viewpoints

[ISO 15926-1:2004, definition 3.1.7]

2.1.10

document

thing serving as a representation of information by means of symbolic marks

NOTE The word “document” is used in a wider sense. Next to the information content of customary (paper) documents (not a paper document itself, because that is an instance of PhysicalObject), such as equipment data sheets or purchase orders, it can also be used for other sets of data, like the transaction data that are input to an engineering program or data sets that are exchanged between systems of business partners

2.1.11**entity**

class of information defined by common properties

[ISO 10303-11:2004, definition 3.3.6]

2.1.12**entity instance**

named unit of data which represents a unit of information within the class defined by an entity

NOTE 1 It is a member of the domain established by an entity data type.

NOTE 2 Adapted from ISO 10303-11:2004, definition 3.3.8.

2.1.13**first-order logic**

symbolized reasoning in which each sentence, or statement, is broken down into a subject and a predicate

NOTE 1 The predicate modifies or defines the properties of the subject. In first-order logic, a predicate can only refer to a single subject.

NOTE 2 First-order logic is also known as first-order predicate calculus or first-order functional calculus.

2.1.14**individual template**

template for making statements about individuals

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2.1.15**instance**

named value

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[ISO 10303-11:2004, definition 3.3.10]

2.1.16**ISO 15926-2 language**

first-order language in which the ISO 15926-2 data model is expressed

NOTE The ISO 15926-2 language is specified in 4.1.

2.1.17**life-cycle information**

information about a **possible individual**, collected at any point in time during the life-cycle of that individual

NOTE In ISO 15926-2:2003, definition 3.1.6, "individual" is defined as: "thing that exists in space and time".

2.1.18**RDL template**

template with at least one reference data item in the expansion of its template axiom

2.1.19

reference data

process plant life-cycle data that represents information about classes or individuals which are common to many process plants or of interest to many users

[ISO 15926-1:2004, definition 3.1.18]

2.1.20

reference data library

RDL

managed collection of reference data

[ISO 15926-1:2004, definition 3.1.19]

NOTE In ISO/TS 15926-8 “RDL” and “ontology” are used interchangeably. An alternative term is “information model”.

2.1.21

reification

modelling style in which a relationship is expressed as an object class

EXAMPLE The relation Employed-by is reified by the object Employment which is connected to the objects Employee and Organization. The meaning of the relation with cardinalities at both ends is “an organization has zero or more employees”. The reified Employment object can be subject in other relations, defining it.

NOTE The relational entity types of ISO 15926 are all the entity types which have exactly two attributes, except **class_of_relationship**.

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2.1.22

template

set comprising of a first-order logic predicate for which a definition is stated as an axiom, a template signature and a template axiom expansion

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2.1.23

template expansion

template axiom expansion

statement expressed in ISO 15926-2 entity data types, equivalent to a template axiom

NOTE The expansion of a template axiom refers to a typically complex, biconditional in the ISO 15926-2 language. It is obtained by repeated application of template biconditionals until the template’s interpretation is expressed directly in terms of simple ISO 15926-2 language constructions.

2.1.24

template instance expansion

set of simple statements in the ISO 15926-2 language, obtained by instantiating variables in the expanded template axiom with entity instances

2.1.25

template axiom

axiom in the template language defining the interpretation of template statements

2.1.26

template instance

ordered list of entity instances of which a template is true

2.1.27**template language**

axioms in first-order logic extending the ISO 15926-2 data model

2.1.28**template role**

named and numbered argument in a template with required type given as entity type, data type, or reference data class

EXAMPLE Template InstanceOfIndirectProperty(a, b, c) means that a is a ClassOfIndirectProperty, b a (temporal part of) PossibleIndividual to which the relation applies and c the instance of Property. b has ap a type of ClassOfIndirectProperty, which has c'c instance of Property. It has the following roles:

- a) role name: Property type;
- b) role name: Property possessor;
- c) role name: Property.

2.1.29**template signature**

named, ordered and typed list of template roles

EXAMPLE Template InstanceOfIndirectProperty(a, b, c) means that a is a ClassOfIndirectProperty, b a (temporal part of) PossibleIndividual to which the relation applies and c the instance of Property. b has ap a type of ClassOfIndirectProperty, which has c'c instance of Property. The template signature is:

- a) role name: Property type, role type: **ClassOfIndirectProperty**;
- b) role name: Property possessor, role type: **PossibleIndividual**;
- c) role name: Property, role type: **Property**.

2.1.30**template statement**

statement made by instantiating the roles of a template with entity instances

2.1.31**value**

unit of data

[ISO 10303-11:2004, definition 3.3.22]

2.2 Abbreviated terms

FOL	first order logic
DL	description logic
RDL	reference data library