

PRE-STANDARD

**Function blocks for industrial-process
measurement and control systems –**

**Part 2:
Software tools requirements**

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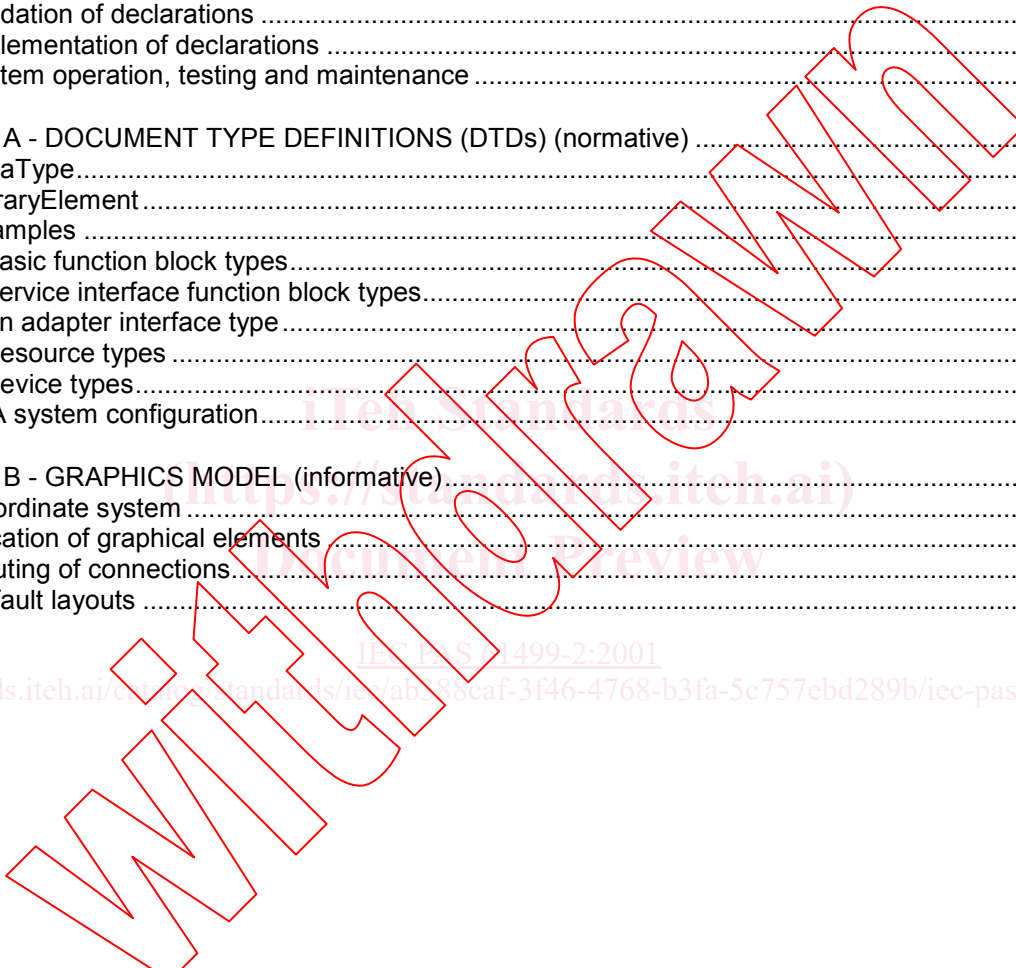


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TABLE OF CONTENTS

1. GENERAL REQUIREMENTS	4
1.1 Scope.....	4
1.2 Normative references	4
1.3 Definitions	5
2. SOFTWARE TOOL REQUIREMENTS	5
2.1 Information to be provided by the software tool supplier.....	5
2.2 Exchange of library elements	5
2.3 Information to be provided by the supplier of library elements	5
2.4 Display of declarations	6
2.5 Modification of declarations	6
2.6 Validation of declarations	6
2.7 Implementation of declarations	6
2.8 System operation, testing and maintenance	6
ANNEX A - DOCUMENT TYPE DEFINITIONS (DTDs) (normative)	7
A.1 DataType.....	8
A.2 LibraryElement	13
A.3 Examples	22
A.3.1 Basic function block types.....	22
A.3.2 Service interface function block types.....	26
A.3.3 An adapter interface type.....	29
A.3.4 Resource types	30
A.3.5 Device types.....	32
A.3.6 A system configuration.....	33
ANNEX B - GRAPHICS MODEL (informative).....	37
B.1 Coordinate system	37
B.2 Location of graphical elements	38
B.3 Routing of connections.....	38
B.4 Default layouts	38



LIST OF TABLES

Table A.0 - Document Type Definitions (DTDs).....7
Table A.1-1 - DataType DTD.....8
Table A.1-2 - DataType DTD Elements.....9
Table A.2-1 - Library Element DTD.....13
Table A.2-2 - LibraryElement DTD Elements.....17

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FUNCTION BLOCKS FOR INDUSTRIAL-PROCESS MEASUREMENT AND CONTROL SYSTEMS

PART 2: SOFTWARE TOOLS REQUIREMENTS

FOREWORD

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public and established in an organization operating under given procedures.

IEC-PAS 61499-2 has been processed by working group 6 of IEC technical committee 65: Industrial-process measurement and control.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P members of the committee concerned as indicated in the following document:

Draft PAS	Report on voting
65/260/PAS	65/265/RVD

Following publication of this PAS, the technical committee or subcommittee concerned will investigate the possibility of transforming the PAS into an International Standard.

This is Part 2 of a projected three-part Standard under development by Working Group 6 of IEC Technical Committee 65.

The projected parts of the standard are:

- Part 1 – Architecture
- Part 2 – Software Tool Requirements
- Part 3 – Application Guidelines

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
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- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this PAS may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

1. GENERAL REQUIREMENTS

1.1 Scope

This Standard consists of two Parts:

- Part 1, "Architecture", contains:
 - general requirements, including an introduction, scope, normative references, definitions, and reference models;
 - rules for the declaration of *function block types*, and rules for the behavior of *instances* of the types so declared;
 - rules for the use of function blocks in the *configuration* of distributed industrial-process measurement and control *systems* (IPMCSs);
 - rules for the use of function blocks in meeting the communication requirements of distributed IPMCSs;
 - rules for the use of function blocks in the management of *applications*, *resources* and *devices* in distributed IPMCSs;
 - requirements to be met by compliant systems and standards.
- This Part defines requirements for *software tools* to support the following systems engineering tasks enumerated in subclause 1.1 of IEC 61499-1:
 - the specification of *function block types*;
 - the functional specification of *resource types* and *device types*;
 - the specification, analysis, and validation of distributed IPMCSs;
 - the *configuration*, *implementation*, operation, and maintenance of distributed IPMCSs;
 - the exchange of *information* among *software tools*.

It is assumed that such *software tools* may be used in the context of an Engineering Support System (ESS) as described in Annex C 1 of IEC 61499-1.

- Part 3, "Application Guidelines," contains examples of the application of software tools in various stages of engineering methodologies for the performance of the tasks enumerated above.

It is beyond the scope of this Standard to specify the entire life cycle of industrial-process IPMCSs, or the entire set of tasks and activities required to support an IPCMS over its life cycle. However, other standards which do specify such tasks and activities may extend or modify the requirements specified in this Part.

1.2 Normative references

The normative references given in IEC 61499-1 also apply to this Part. In addition, the following document contains normative provisions that are used in an informative manner in Annex A of this Part.

17B/1022/CD, Draft IEC 61915: Low-voltage switchgear and controlgear - Profiles for networked industrial devices, 12 October 1999

All normative documents are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated above. Members of the IEC and ISO maintain registers of currently valid International Standards.

1.3 Definitions

The definitions given in IEC 61499-1 also apply to this Part. In addition, the following definitions apply for the purposes of this Part.

1.3.1. library element: The collection of *declarations* applying to a *data type*, *function block type*, *adapter type*, *subapplication type*, *resource type*, *device type*, or *system configuration*.

2. SOFTWARE TOOL REQUIREMENTS

This Clause defines the functional requirements of *software tools* which support the performance of the systems engineering tasks enumerated in subclause 1.1.

2.1 Information to be provided by the software tool supplier

The supplier of a *software tool* shall specify the following information in addition to other information which may be required in this Clause:

1. The type or types of *library element* to which the software tool applies.
2. The engineering task or tasks supported by the software tool. Task descriptions may be taken from the enumeration of engineering tasks given in subclause 1.1 or may be defined by the supplier.

2.2 Exchange of library elements

A *software tool* shall be capable of exchanging its *library elements* with other software tools. This exchange shall take the form of *data* in the format defined in Annex A, written on physical media or exchanged over communication links or networks

2.3 Information to be provided by the supplier of library elements

NOTE The provisions of this subclause are intended to provide the means by which the provider of a library element may achieve protection of intellectual property while still providing sufficient information to permit the effective use of the library element.

The provider of a *library element* may elect to provide an *implementation* of the library element.

EXAMPLE 1) The provider of a *function block type* library element may provide an implementation of the function block type as:

- one or more *instances* of the function block type in a *resource* contained in a *device* of Class 0 or higher as specified in IEC 61499-1-5.1;
- an instantiable implementation of the function block type in a *resource* contained in a *device* of Class 1 or higher as specified in IEC 61499-1-5.1;
- a file in an **implementation-dependent** format suitable for installation in a *resource* contained in a *device* of Class 2 as specified in IEC 61499-1-5.1, for instance using the IEC61499-FBMGT syntax defined in IEC 61499-1-F.3.1.2.

When an implementation of a library element is provided, the provider is not required to provide full details of the implementation. However, the provider shall provide sufficient information to enable the user to fully determine the functionality of the provided library element.

EXAMPLE 2) The requirement of the above paragraph would be met by the provider of an *instance* of a function block type in a *resource* through the provision, at a minimum, of the following information:

- a *function block type* library element specifying its *event* and *data interfaces* as defined in IEC 61499-1-2.2.1, and its *services* as defined in IEC 61499-1-3.1.2;
- *resource type* and *device type* library elements showing the occurrence and connections of the function block *instances*.

2.4 Display of declarations

A software tool shall be capable of displaying the *declarations* of its associated *library elements* in a form appropriate to the engineering task. This display may utilize the graphical or textual formats defined in IEC 61499-1, or a format defined by the supplier of the software tool.

NOTE The *declarations* of a library element may define its *interfaces* (event and data inputs and outputs) and internal *variables* as well as its *algorithms* and the control of their *execution*, for example via an *execution control chart* (ECC), etc.

2.5 Modification of declarations

A software tool shall enable its user to modify the declarations of its associated library elements as appropriate to the engineering task. Such modifications may include adding, deleting or changing the contents of declarations, and may be performed either graphically or textually or both.

2.6 Validation of declarations

If required by the associated engineering task, a software tool shall provide facilities for validation of the declarations of its associated library elements. Such facilities may include, but are not limited to:

1. Checking the correctness of the syntax of declarations.
2. Checking the semantic correctness of declarations, for instance, checking whether all *function block instances* in an *application* and its associated *sub applications* are properly allocated to *resources*, interconnected within resources, and intercommunicating among resources in a *system configuration*.
3. Simulation and testing of the operation of an *instance* of a library element *type*, either by itself or in association with other instances of the same or different types.

2.7 Implementation of declarations

If required by the associated engineering task, a software tool shall provide facilities for the *implementation* of the *declarations* of its associated *library elements*. Such facilities may include, but are not limited to:

1. The production of executable code ("firmware") for embedding in *instances* of *resource types* and *device types*.
2. The creation and interconnection ("downloading") of *function block instances* in *resources* and *devices*, for instance by using the management facilities defined in subclause 3.3 and Annexes F and G of IEC 61499-1.

2.8 System operation, testing and maintenance

If required by the associated engineering task, a software tool shall provide facilities for the operation, testing and maintenance of an Industrial Process Measurement and Control System (IPMCS) specified by its associated library elements. Such facilities may include, but are not limited to:

1. The facilities described in preceding subclauses of this Clause.
2. The information exchange facilities defined in subclause 3.2 and Annex F of IEC 61499-1.

ANNEX A - DOCUMENT TYPE DEFINITIONS (DTDs) (normative)

NOTE If there is a conflict between the provisions of this Annex and the provisions of Annex B of IEC 61499-1, the provisions of the latter shall prevail.

This Annex presents Document Type Descriptions (DTDs) for the exchange of IEC 61499 library elements between *software tools*. These DTDs are defined in the syntax defined in the eXtended Markup Language (XML) specification at <http://www.w3.org/TR/1998/REC-xml-19980210>.

The correspondences between the DTDs given in this Annex, the library elements defined in IEC 61499-1-C.1.1, and the textual syntax given in IEC 61499-1-B are given in Table A.0. The first table of each subclause of this Annex contains the DTD for the corresponding library element. The second table of each subclause provides a reference to the textual syntax (if any) plus an explanation for the major elements and attributes in the DTD. Following this, examples are given of the resulting XML files for typical library elements.

NOTE The examples given in this Annex provide a representative but not exhaustive sample of the features of the associated DTDs. In particular, these examples are not intended to be used as a test suite for compliance to the provisions of this Part.

Table A.0 - Document Type Definitions (DTDs)

DTD	LibraryElement	Textual Syntax
DataType	DataTypeDeclaration	data_type_declaration (IEC 61131-3-B.1.3)
FBType	FBTypeDeclaration	fb_type_declaration
SubapplicationType	SubapplicationTypeDeclaration	subapplication_type_declaration
AdapterType	AdapterTypeDeclaration	adapter_type_declaration
ResourceType	ResourceTypeDeclaration	resource_type_specification
DeviceType	DeviceTypeDeclaration	device_type_specification
System	SystemConfiguration	system_configuration

A.1 DataType

An XML document complying with the DTD in Table A.1-1 represents a **DataTypeDeclaration** object as described in Annex C.1.1 of IEC 61499-1.

Table A.1-1 - DataType DTD

<pre><?xml version="1.0" encoding="UTF-8"?> <!ELEMENT DataType (Identification?,VersionInfo+,CompilerInfo?,ASN1Tag?,(DirectlyDerivedType EnumeratedType SubrangeType ArrayType StructuredType))> <!ATTLIST DataType Name CDATA #REQUIRED Comment CDATA #IMPLIED ></pre>
<pre><!ELEMENT VersionInfo EMPTY> <!ATTLIST VersionInfo Organization CDATA #REQUIRED Version CDATA #REQUIRED Author CDATA #REQUIRED Date CDATA #REQUIRED Remarks CDATA #IMPLIED ></pre>
<pre><!ELEMENT ASN1Tag EMPTY> <!ATTLIST ASN1Tag Class (UNIVERSAL APPLICATION CONTEXT PRIVATE) #IMPLIED Number CDATA #REQUIRED ></pre>
<pre><!ELEMENT CompilerInfo (Compiler*)*> <!ATTLIST CompilerInfo header CDATA #IMPLIED clasdef CDATA #IMPLIED ></pre>
<pre><!ELEMENT Compiler EMPTY> <!ATTLIST Compiler Language (Java Cpp C Other) #REQUIRED Vendor CDATA #REQUIRED Product CDATA #REQUIRED Version CDATA #REQUIRED ></pre>
<pre><!ELEMENT DirectlyDerivedType EMPTY> <!ATTLIST DirectlyDerivedType BaseType (BOOL SINT INT DINT LINT USINT UINT UDINT ULINT REAL LREAL TIME DATE TIME_OF_DAY DATE_AND_TIME STRING BYTE WORD DWORD LWORD WSTRING) #REQUIRED InitialValue CDATA #IMPLIED Comment CDATA #IMPLIED ></pre>
<pre><!ELEMENT EnumeratedType (EnumeratedValue)+> <!ATTLIST EnumeratedType InitialValue IDREF #IMPLIED ></pre>
<pre><!ELEMENT EnumeratedValue EMPTY> <!ATTLIST EnumeratedValue Name ID #REQUIRED Comment CDATA #IMPLIED ></pre>
<pre><!ELEMENT SubrangeType (Subrange)> <!ATTLIST SubrangeType BaseType (SINT INT DINT LINT USINT UINT UDINT ULINT) #REQUIRED InitialValue CDATA #IMPLIED ></pre>
<pre><!ELEMENT Subrange EMPTY> <!ATTLIST Subrange LowerLimit CDATA #REQUIRED UpperLimit CDATA #REQUIRED ></pre>

Table A.1-1 - DataType DTD

<pre><!ELEMENT ArrayType (Subrange)+> <!ATTLIST ArrayType BaseType CDATA #REQUIRED InitialValues CDATA #IMPLIED Comment CDATA #IMPLIED ></pre>
<pre><!ELEMENT StructuredType (VarDeclaration ArrayVarDeclaration SubrangeVarDeclaration)+> <!ATTLIST StructuredType Comment CDATA #IMPLIED ></pre>
<pre><!ELEMENT VarDeclaration EMPTY > <!ATTLIST VarDeclaration Name ID #REQUIRED Type CDATA #REQUIRED Comment CDATA #IMPLIED InitialValue CDATA #IMPLIED ></pre>
<pre><!ELEMENT ArrayVarDeclaration (Subrange+) > <!ATTLIST ArrayVarDeclaration Name ID #REQUIRED Type CDATA #REQUIRED Comment CDATA #IMPLIED InitialValues CDATA #IMPLIED ></pre>
<pre><!ELEMENT SubrangeVarDeclaration (Subrange?) > <!ATTLIST SubrangeVarDeclaration Name ID #REQUIRED Type (SINT INT DINT LINT USINT UINT UDINT ULINT) #REQUIRED Comment CDATA #IMPLIED InitialValue CDATA #IMPLIED ></pre>

Explanations of the elements of the above DTD, and (where applicable) references to the formal syntax for their attributes, are given in Table A.1-2.

Table A.1-2 - DataType DTD Elements

Element Attributes	Textual Syntax (IEC 61131-3, Annex B)	Explanation
DataType		See IEC 61131-3-
Name	data_type_name	
Comment	--	A comment per IEC 61131-3-2.1.5 without (* and *) delimiters
Identification	--	Information for data base retrieval
Standard	--	Primary reference standard in number-part-subclause format
Classification	--	Classification code as defined in reference standard
ApplicationDomain	--	Application domain as defined in reference standard
Function	--	Function of this element as defined in reference standard
Type	--	Element type (e.g., device type) as defined in reference standard
Description	--	Descriptive phrase as defined in reference standard