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Function Block – Part 2: Software tools requirements

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Functions concerned Fonctions concernées ☐ Safety / Sécurité ☐ EMC / CEM ☐ Environment / Environnement ☐ Quality assurance / Assurance qualité		

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Titre : CEI 61499-2 : Bloc fonctionnel – Partie 2 : Spécifications des outils logiciels.

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Note d'introduction
Selon le plan de travail établi à Madrid

Introductory note
In conformance with work programme revised in Madrid

ATTENTION Parallel IEC CDV/CENELEC Enquiry)	ATTENTION CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)

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FUNCTION BLOCKS –

Part 2: Software tool requirements

FOREWORD

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International Standard IEC 61499-2 has been prepared by Working Group 6, of IEC technical committee 65: Industrial-Process Measurement and Control.

The text of this standard is based on the following documents:

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FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until _____. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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FUNCTION BLOCKS –

Part 2: Software tool requirements

1 General requirements

1.1 Scope

This Standard consists of four 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.
- Part 2 (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 has the purpose to increase the understanding, acceptance, and both generic and domain-specific applicability of IPMCS architectures and software tools meeting the requirements of the other Parts, by providing:
  - Answers to Frequently Asked Questions (FAQs) regarding IEC 61499;
  - Examples of the use of IEC 61499 constructs to solve frequently encountered problems in control and automation engineering.
- Part 4, “Rules for compliance profiles,” defines rules for the development of *compliance profiles* which specify the features of IEC 61499-1 and 61499-2 to be implemented in order to promote the following attributes of IEC 61499-based systems, devices and software tools:
  - interoperability of devices from multiple suppliers;
  - portability of software between software tools of multiple suppliers; and
  - configurability of devices from multiple vendors by software tools of multiple suppliers.

It is beyond the scope of this Standard to specify the entire life cycle of industrial-process measurement and control systems (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.

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1.2 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.

The normative references given in IEC 61499-1 also apply to this Part.

1.3 Definitions

For the purposes of this document, the terms and definitions given in IEC 61499-1 and the following apply:

1.3.1
library element
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

2.1 Information to be provided by the software tool supplier

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

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The supplier of a *software tool* shall specify the following information in addition to other information 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.

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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 described in IEC 61499-4;
- an instantiable implementation of the function block type in a *resource* contained in a *device* of Class 1 or higher as described in IEC 61499-4;
- a file in an **implementation-dependent** format suitable for installation in a *resource* contained in a *device* of Class 2 as described in IEC 61499-4, for instance using the XML syntax defined in Annex D.

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.

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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

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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 *subapplications* 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.

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Annex A
(normative)
Document Type Definitions (DTDs)

A.1 General principles

This Annex presents Document Type Definitions (DTDs) for the exchange of IEC 61499 library elements between *software tools*. These DTDs are defined in the syntax defined in the eXtensible Markup Language (XML) specification at www.w3.org/TR/2000/REC-xml-20001006.

The correspondences between the DTD elements 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.1.

Table A.1 - Document Type Definition (DTD) elements

DTD element	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

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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.

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NOTE 1 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.

NOTE 2 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.

A.2 DataType DTD

An XML document complying with the DTD in Table A.2 represents a **DataTypeDeclaration** object as described in Annex C.1 of IEC 61499-1.

Table A.2 - DataType DTD

```
<?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>
```

Table A.2 - DataType DTD

```
<!ELEMENT Identification EMPTY>
<!ATTLIST Identification
 Standard CDATA #IMPLIED
 Classification CDATA #IMPLIED
 ApplicationDomain CDATA #IMPLIED
 Function CDATA #IMPLIED
 Type CDATA #IMPLIED
 Description CDATA #IMPLIED>
```

```
<!ELEMENT VersionInfo EMPTY>
<!ATTLIST VersionInfo
 Organization CDATA #REQUIRED
 Version CDATA #REQUIRED
 Author CDATA #REQUIRED
 Date CDATA #REQUIRED
 Remarks CDATA #IMPLIED>
```

```
<!ELEMENT ASN1Tag EMPTY>
<!ATTLIST ASN1Tag
 Class (UNIVERSAL | APPLICATION | CONTEXT | PRIVATE) #IMPLIED
 Number CDATA #REQUIRED>
```

```
<!ELEMENT CompilerInfo (Compiler*)>
<!ATTLIST CompilerInfo
 header CDATA #IMPLIED
 classdef CDATA #IMPLIED>
```

```
<!ELEMENT Compiler EMPTY>
<!ATTLIST Compiler
 Language (Java | Cpp | C | Other) #REQUIRED
 Vendor CDATA #REQUIRED
 Product CDATA #REQUIRED
 Version CDATA #REQUIRED>
```

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```
<!ELEMENT DirectlyDerivedType EMPTY>
<!ATTLIST DirectlyDerivedType
 BaseType (BOOL | SINT | INT | DINT | LINT | USINT | UINT | UDINT
| ULINT | REAL | LREAL | TIME | DATE | TIME_OF_DAY | TOD
| DATE_AND_TIME | DT | STRING | BYTE |WORD | DWORD |LWORD | WSTRING)
  #REQUIRED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT EnumeratedType (EnumeratedValue+)>
<!ATTLIST EnumeratedType
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT EnumeratedValue EMPTY>
<!ATTLIST EnumeratedValue
 Name CDATA #REQUIRED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT SubrangeType (Subrange)>
<!ATTLIST SubrangeType
 BaseType (SINT|INT|DINT|LINT|USINT|UINT|UDINT|ULINT) #REQUIRED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT Subrange EMPTY>
<!ATTLIST Subrange
 LowerLimit CDATA #REQUIRED
 UpperLimit CDATA #REQUIRED>
```

```
<!ELEMENT ArrayType (Subrange+)>
<!ATTLIST ArrayType
 BaseType CDATA #REQUIRED
 InitialValues CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

Table A.2 - DataType DTD

```
<!ELEMENT StructuredType (VarDeclaration|SubrangeVarDeclaration)+>
<!ATTLIST StructuredType
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT VarDeclaration EMPTY >
<!ATTLIST VarDeclaration
 Name CDATA #REQUIRED
 Type CDATA #REQUIRED
 ArraySize CDATA #IMPLIED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

```
<!ELEMENT SubrangeVarDeclaration (Subrange+) >
<!ATTLIST SubrangeVarDeclaration
 Name CDATA #REQUIRED
 Type (SINT|INT|DINT|LINT|USINT|UINT|UDINT|ULINT) #REQUIRED
 InitialValue CDATA #IMPLIED
 Comment CDATA #IMPLIED>
```

Explanations of the elements of the above DTD, and (where applicable) references to the formal syntax for their attributes, are given in Table A.3.

Table A.3 - 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 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
VersionInfo	--	Possibly one of several entries: First entry - Most recent version 2nd entry - Immediately preceding released version... last entry - First released version
Organization	--	The organization supplying this library element
Version	digit [digit] '.' digit [digit] [letter]	The Version identification for this library element
Author	--	The author of this library element
Date	date_literal ['-' daytime]	The release date of this version
Remarks	--	Comments relating to this version
ASN1Tag		ASN.1 tag per ISO/IEC 8824
Class		ASN.1 tag class per ISO/IEC 8824
Number		ASN.1 tag number per ISO/IEC 8824

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