

**Programmable controllers - Part 10: PLC open XML
exchange format**

EESTI STANDARDI EESSÕNA**NATIONAL FOREWORD**

See Eesti standard EVS-EN IEC 61131-10:2019 sisaldab Euroopa standardi EN IEC 61131-10:2019 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 61131-10:2019 consists of the English text of the European standard EN IEC 61131-10:2019.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 12.07.2019.	Date of Availability of the European standard is 12.07.2019.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 25.040.40, 35.240.30, 35.240.50

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

ICS 25.040.40; 35.240.30; 35.240.50

English Version

**Programmable controllers - Part 10: PLC open XML exchange
format
(IEC 61131-10:2019)**

Automates programmables - Partie 10: Format d'échange
XML ouvert PLC
(IEC 61131-10:2019)

Speicherprogrammierbare Steuerungen - Teil 10: XML-
basiertes Austauschformat für Programme nach IEC 61131-
3
(IEC 61131-10:2019)

This European Standard was approved by CENELEC on 2019-05-29. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 65B/1147/FDIS, future edition 1 of IEC 61131-10, prepared by SC 65B "Measurement and control devices" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61131-10:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-02-29
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-05-29

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61131-10:2019 was approved by CENELEC as a European Standard without any modification.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61131-1	-	Programmable controllers - Part 1: General information	EN 61131-1	-
IEC 61131-3	-	Programmable controllers - Part 3: Programming languages	EN 61131-3	-

CONTENTS

FOREWORD.....	8
INTRODUCTION.....	10
1 Scope.....	11
1.1 General.....	11
1.2 Implementation specific parameters.....	12
2 Normative references.....	13
3 Terms, definitions, abbreviated terms and acronyms.....	13
3.1 General terms and definitions.....	13
3.2 Abbreviated terms.....	13
4 Overview of schema concepts.....	14
4.1 Schema versioning.....	14
4.2 Naming conventions.....	14
4.3 Coordinate system of graphical languages.....	14
4.4 Schema extension concepts.....	17
5 Compliance.....	18
5.1 General.....	18
5.2 Feature tables.....	18
5.3 Vendor's compliance statement.....	18
6 Main schema element "Project".....	19
6.1 General.....	19
6.2 "FileHeader".....	19
6.3 "ContentHeader".....	20
6.4 "Types".....	21
6.5 "Instances".....	21
6.5.1 General ("Configuration").....	21
6.5.2 "Resource".....	22
6.5.3 "AccessVars".....	25
6.5.4 "ConfigVars".....	25
7 Abstract complex types.....	26
7.1 Purpose of abstract complex types.....	26
7.2 Abstract complex types for data type specifications.....	27
7.2.1 General.....	27
7.2.2 "TypeSpecBase".....	27
7.2.3 "InstantlyDefinableTypeSpecBase".....	27
7.3 Abstract complex types for behaviour representations.....	27
7.3.1 General.....	27
7.3.2 "BehaviourRepresentationBase".....	28
7.3.3 "ProgrammingLanguageBase".....	28
7.4 Abstract complex types for graphical objects.....	28
7.4.1 General.....	28
7.4.2 "IdentifiedObjectBase".....	30
7.4.3 "GraphicalObjectBase".....	30
7.4.4 "CommonObjectBase".....	31
7.4.5 "FbdObjectBase".....	31
7.4.6 "LdObjectBase".....	31
7.4.7 "SfcObjectBase".....	32

7.4.8	"NetworkBase"	32
7.5	Abstract complex types for textual constructs	33
7.5.1	General	33
7.5.2	"TextualObjectBase"	34
7.5.3	"NamespaceContentBase"	35
7.5.4	"TaskBase"	36
8	Namespace declaration	36
9	User-defined data type declaration	37
9.1	"UserDefinedTypeDecl"	37
9.2	"ArrayTypeSpec"	37
9.3	"DirectlyDerivedTypeSpec"	38
9.4	"EnumTypeSpec"	38
9.5	"EnumTypeWithNamedValueSpec"	39
9.6	"StructTypeSpec"	39
9.7	"SubrangeTypeSpec"	40
9.8	"ReferenceTypeSpec"	40
9.9	"ElementaryType"	41
10	POU declaration	41
10.1	"PouDecl"	41
10.2	"Program"	41
10.3	"FunctionBlock"	43
10.4	"Class"	44
10.5	"Function"	45
10.6	"Interface"	46
10.7	"Action"	46
10.8	"NamedTransition"	47
10.9	"MethodPrototype"	47
10.10	"Method"	48
10.11	"ParameterSet"	50
10.12	"VarListWithAccessSpec"	52
10.13	"AccessSpecifiers"	52
10.14	"Body"	52
10.15	"BodyWithoutSFC"	53
10.16	"Predicate"	53
11	Variable declaration	54
11.1	"VarList"	54
11.2	"ExternalVarList"	55
11.3	"VariableDecl"	55
11.4	"VariableDeclPlain"	56
11.5	"TypeRef"	56
11.6	"Value"	56
11.7	"AddressExpression"	57
11.8	"FixedAddressExpression"	58
12	Behaviour representation	58
12.1	"IL"	58
12.2	"ST"	58
12.3	"FBD"	59
12.4	"FbdNetwork"	59

12.5	"LD"	59
12.6	"LadderRung"	60
12.7	"SFC"	60
13	Graphical behaviour representation	60
13.1	General	60
13.2	Common elements	61
13.2.1	"Comment"	61
13.2.2	"Connector"	61
13.2.3	"Continuation"	62
13.2.4	"ActionBlocks"	62
13.3	FBD elements	64
13.3.1	"Block"	64
13.3.2	"graphicalFormalParameterCommon"	67
13.3.3	"DataSource"	67
13.3.4	"DataSink"	68
13.3.5	"Unconnected"	68
13.3.6	"Jump"	69
13.3.7	"Return"	70
13.4	LD elements	70
13.4.1	"LeftPowerRail"	70
13.4.2	"RightPowerRail"	71
13.4.3	"Coil"	71
13.4.4	"Contact"	72
13.4.5	"CompareContact"	73
13.5	SFC elements	74
13.5.1	"Step"	74
13.5.2	"Transition"	75
13.5.3	"SelectionDivergence"	76
13.5.4	"SelectionConvergence"	77
13.5.5	"SimultaneousDivergence"	78
13.5.6	"SimultaneousConvergence"	78
13.6	Connections	79
13.6.1	General	79
13.6.2	"ConnectionPointIn"	79
13.6.3	"Connection"	80
13.6.4	"FeedbackConnection"	81
13.6.5	"ConnectionPointOut"	81
14	Resource declaration	82
14.1	"StandardTask"	82
14.2	"ParameterAssignment"	82
15	Miscellaneous	82
15.1	"XyDecimalValue"	82
15.2	"AddData"	83
15.3	"TextBase"	83
15.4	"SimpleText"	83
15.5	"EdgeModifierType"	84
Annex A	(normative) Formal XML exchange format schema definition	85
Annex B	(informative) Recommended schemata	161

B.1	General.....	161
B.2	Recommended schemata to be used by "AddData"	164
B.3	Recommended schemata to be used by abstract complex type	172
Annex C (informative) Example XML document.....		190
Bibliography.....		276
Figure 1	– Main overview of XML exchange format usage (example)	11
Figure 2	– Mapping coordinate information to the coordinate system	15
Figure 3	– Transforming position using the scaling information	15
Figure 4	– Objects anchor points and object rectangles examples	17
Figure 5	– Main schema element "Project"	19
Figure 6	– Element "FileHeader"	20
Figure 7	– Element "ContentHeader"	20
Figure 8	– Element "Types"	21
Figure 9	– Element "Instances"	22
Figure 10	– Element "Resource"	23
Figure 11	– Element "ProgramInstance"	24
Figure 12	– Element "AccessVars"	25
Figure 13	– Element "ConfigVars"	26
Figure 14	– Extension relationship among complex types for data type specifications	27
Figure 15	– Extension relationship among complex types for behaviour representations	28
Figure 16	– Extension relationship among complex types for graphical objects	29
Figure 17	– Complex type "IdentifiedObjectBase"	30
Figure 18	– Complex type "GraphicalObjectBase"	30
Figure 19	– Complex type "CommonObjectBase"	31
Figure 20	– Complex type "FbdObjectBase"	31
Figure 21	– Complex type "LdObjectBase"	32
Figure 22	– Complex type "SfcObjectBase"	32
Figure 23	– Complex type "NetworkBase"	33
Figure 24	– Extension relationship among complex types for textual objects	34
Figure 25	– Complex type "TextualObjectBase"	35
Figure 26	– Complex type "NamespaceContentBase"	35
Figure 27	– Complex type "TaskBase"	36
Figure 28	– Complex type "NamespaceDecl"	36
Figure 29	– Complex type "UserDefinedTypeDecl"	37
Figure 30	– Complex type "ArrayTypeSpec"	38
Figure 31	– Complex type "DirectlyDerivedTypeSpec"	38
Figure 32	– Complex type "EnumTypeSpec"	39
Figure 33	– Complex type "EnumTypeWithNamedValueSpec"	39
Figure 34	– Complex type "StructTypeSpec"	40
Figure 35	– Complex type "SubrangeTypeSpec"	40
Figure 36	– Complex type "ReferenceTypeSpec"	40
Figure 37	– Complex type "PouDecl"	41

Figure 38 – Complex type "Program"	42
Figure 39 – Complex type "FunctionBlock"	43
Figure 40 – Complex type "Class"	44
Figure 41 – Complex type "Function"	45
Figure 42 – Complex type "Interface"	46
Figure 43 – Complex type "Action"	46
Figure 44 – Complex type "NamedTransition"	47
Figure 45 – Complex type "MethodPrototype"	48
Figure 46 – Complex type "Method"	49
Figure 47 – Complex type "ParameterSet"	51
Figure 48 – Complex type "VarListWithAccessSpec"	52
Figure 49 – Complex type "Body"	53
Figure 50 – Complex type "BodyWithoutSFC"	53
Figure 51 – Complex type "Predicate"	54
Figure 52 – Complex type "VarList"	54
Figure 53 – Complex type "ExternalVarList"	55
Figure 54 – Complex type "VariableDecl"	55
Figure 55 – Complex type "VariableDeclPlain"	56
Figure 56 – Complex type "TypeRef"	56
Figure 57 – Complex type "Value"	57
Figure 58 – Complex type "AddressExpression"	57
Figure 59 – Complex type "FixedAddressExpression"	58
Figure 60 – Complex type "IL"	58
Figure 61 – Complex type "ST"	58
Figure 62 – Complex type "FBD"	59
Figure 63 – Complex type "FbdNetwork"	59
Figure 64 – Complex type "LD"	59
Figure 65 – Complex type "LadderRung"	60
Figure 66 – Complex type "SFC"	60
Figure 67 – Complex type "Comment"	61
Figure 68 – Complex type "Connector"	61
Figure 69 – Complex type "Continuation"	62
Figure 70 – Complex type "ActionBlocks"	63
Figure 71 – Complex type "Block"	66
Figure 72 – Complex type "DataSource"	67
Figure 73 – Complex type "DataSink"	68
Figure 74 – Complex type "Unconnected"	69
Figure 75 – Complex type "Jump"	69
Figure 76 – Complex type "Return"	70
Figure 77 – Complex type "LeftPowerRail"	70
Figure 78 – Complex type "RightPowerRail"	71
Figure 79 – Complex type "Coil"	72
Figure 80 – Complex type "Contact"	73

Figure 81 – Complex type "CompareContact"	74
Figure 82 – Complex type "Step"	75
Figure 83 – Complex type "Transition"	76
Figure 84 – Complex type "SelectionDivergence"	77
Figure 85 – Complex type "SelectionConvergence"	78
Figure 86 – Complex type "SimultaneousDivergence"	78
Figure 87 – Complex type "SimultaneousConvergence"	79
Figure 88 – Complex type "ConnectionPointIn"	80
Figure 89 – Complex type "Connection"	80
Figure 90 – Complex type "FeedbackConnection"	81
Figure 91 – Complex type "ConnectionPointOut"	81
Figure 92 – Complex type "StandardTask"	82
Figure 93 – Complex type "ParameterAssignment"	82
Figure 94 – Complex type "XyDecimalValue"	83
Figure 95 – Complex type "AddData"	83
Figure 96 – Complex type "TextBase"	83
Figure 97 – Complex type "SimpleText"	84
Figure B.1 – Only IEC 61131-3 features	161
Figure B.2 – Vendor specific extensions "AddData"	162
Figure B.3 – Vendor specific extensions (abstract complex type)	163

INTRODUCTION

The International Standard IEC 61131 describes programmable logic controllers (PLCs).

IEC 61131-3 defines programming languages. Users want standardized programming languages and the ability to exchange a complete program or parts of that program between different development environments, i.e. from an exporting environment to an importing environment.

IEC 61131-3 defines program organization units (POUs). But an entire program also consists of user-defined data types, global and external declarations and other elements besides the POUs. In this document, the term "IEC 61131-3 project" is used. It contains all above-mentioned language elements, required for an exchange, in order to get a consistent program in the importing environment.

The exchange of POUs developed in one of the textual languages, i.e. instruction list (IL) and structured text (ST) or the textual representation of sequential function charts (SFC) is possible, because a syntax description of these languages is part of the IEC 61131-3 standard. The objective of this document is to extend the reuse of programmed solutions both for textual languages and graphical languages, i.e. function block diagram (FBD) and ladder diagram (LD) or the graphical representation of SFCs. Furthermore, the completeness of exchange between the different environments depends on the supported features that are listed in the compliance list defined in IEC 61131-3.

This document defines a solution independent eXtensible Markup Language (XML) based exchange format, to be supported by interfaces of different kinds of software tools. Beside textual and program logic information, it also provides the ability to transfer graphical representation information, e.g. the position and size of function blocks and how they are connected. The design of the 'transferred' parts shall represent the same program logic, however it may be altered in look and feel.

This document's XML exchange format enables a transfer of IEC 61131-3 projects, from an exporting environment to an importing environment, including extensions for layout and formatting.

This document's XML exchange format can not only describe correct IEC 61131-3 POUs, but it can represent a working state of the IEC 61131-3 project. For example, even if the IEC 61131-3 source project is incomplete, for example if it contains compile errors, it can be represented.

Syntactically incorrect IEC 61131-3 projects can be represented. For example, such a project could be an in-between version or a project containing several unconnected FBD blocks.

This document's XML exchange format provides for life cycle management of automation systems, e.g. in case of redesign, maintenance or device replacement. If an IEC 61131-3 project is stored in this standard's XML exchange format, it could be reused independent of a special development environment. And thus, it could be modified and maintained by any other development environment supporting this standard's XML exchange format.

This International Standard was developed using material from PLCopen^{®1}. This document extends PLCopen[®] XML, adopts it to the features of IEC 61131-3:2013 and is therefore not compatible with previous versions of PLCopen[®] XML.

¹ PLCopen[®] is the registered trademark of PLCopen. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

PROGRAMMABLE CONTROLLERS –

Part 10: PLC open XML exchange format

1 Scope

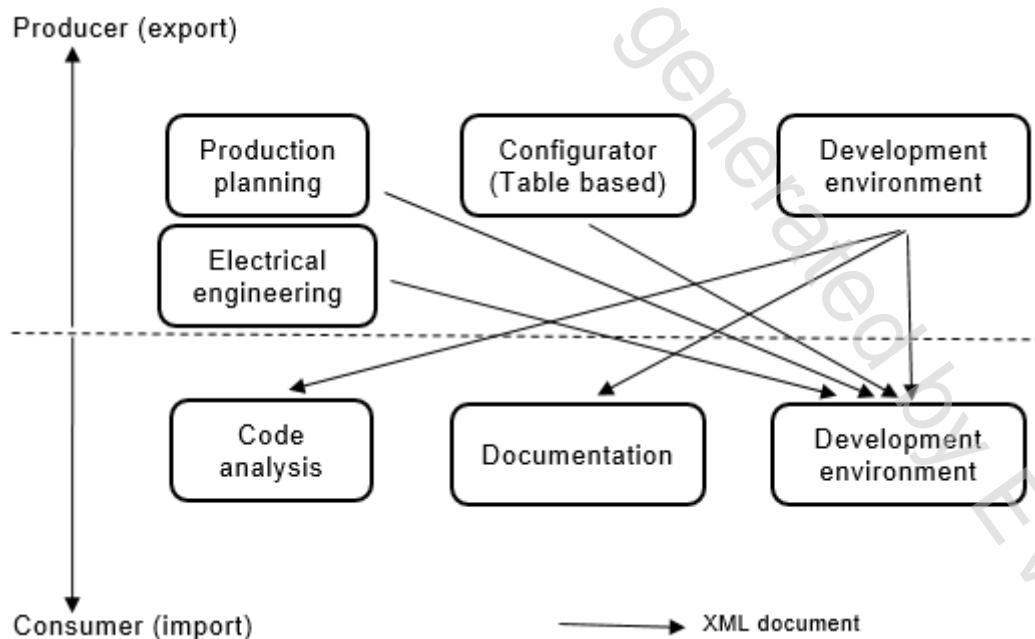
1.1 General

This part of IEC 61131 specifies an XML-based exchange format for the export and import of IEC 61131-3 projects. A complete IEC 61131-3 project implemented in an IEC 61131-3 environment can be transferred between different programming environments. It allows for the exchange of configuration elements, data types, and POU's written in:

- the textual language, instruction list (IL),
- the textual language, structured text (ST),
- the graphical language, ladder diagram (LD),
- the graphical language, function block diagram (FBD), and
- sequential function chart (SFC).

The exchange format is specified as a corresponding XML schema. The XML schema is an independent file with the .xsd extension and as such part of this specification. The specification of this schema is contained in Annex A. Annex B provides recommended schemata for extensions. An example XML document is given in Annex C. It is assumed that the reader of this document is familiar with XML technology.

Figure 1 provides an example overview of the usage of the XML exchange format. Different tools may produce and consume XML based IEC 61131-3 information.



IEC

Figure 1 – Main overview of XML exchange format usage (example)

The usage of the XML exchange format should provide more than a simple export/import from one development environment to another. All relevant information should be exported. This may include coordinate information for graphical tools. The importing tool should be able to filter which parts of this information need to be imported into its destination environment. Vendor-specific information and attributes may be included in the export file and selectively imported, if applicable. The vendor-specific information shall not influence the logic part of the program. Filtering should be done on the import – thus vendors shall ensure that their extensions of the XML schema are done in such a way that neglecting the information during import does not affect the functionality of the IEC 61131-3 project. Vendor specific attributes and information may be added by vendor specific XML schema – besides the XML exchange format defined in this document.

The described formats are designed for the import and export of IEC 61131-3 projects. Such an IEC 61131-3 project can be under development and as a consequence be incomplete.

Concerning the exchange of graphical language constructs between different programming systems, the focus is on logical information with optional explicit graphics.

1.2 Implementation specific parameters

This document does not provide means or requirements for compliant functionality (e.g. functional subset which has to be supported by all Programming and Debugging Tools (PADTs)). This document enables the exchange of all possible features defined in IEC 61131-3. Moreover, many implementation-specific features can be expressed using the AddData mechanism.

In some use cases, programs are either transferred from one PADT to another or generated for the use in a different PADT. In both cases, the function set of these PADTs may be different as well as their settings of implementation-dependent parameters. If several PADTs have to be supported/considered, the functionality of the program has to be restricted to the subset supported by all PADTs in question. Some of these functions can be determined from the IEC 61131-3 feature tables of the concerned PADT, for example:

- supported data types and standard functions,
- pre-emptive or non-pre-emptive scheduling,
- SFC with or without a final scan, etc.

Other functions and settings of implementation dependent parameters may require more effort to determine, for example:

- maximum amounts of code or variables per POU,
- maximum length of identifiers (variable name length),
- size of STRING and WSTRING variables with default length or maximum length,
- SFC to evaluate all transition conditions or only those with active steps as predecessors,
- range and precision of data types TIME, DATE, TOD, DT,
- runtime performance of (the POU in) the PLC,
- execution order within a graphical network, etc.

These differences have to be considered for use cases with more than one PADT. In some cases it may be appropriate to use only functionality supported by all concerned PADTs; in other cases, it may be necessary to manually change and test the program after importing into the PADT.

This document does not state requirements regarding compliant functions of the PADT. It defines an exchange format to exchange programs that are compliant with IEC 61131-3.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 61131-1, *Programmable controllers – Part 1: General information*

IEC 61131-3, *Programmable controllers – Part 3: Programming languages*

3 Terms, definitions, abbreviated terms and acronyms

3.1 General terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61131-3 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1.1

IEC 61131-3 project

set of information in accordance with IEC 61131-3 comprising POU types and instances, data types, global variables instances, configurations and resources

3.1.2

abstract complex type

refers to a "complexType" element from the XML schema definition, which has additionally the "abstract" attribute set to true

3.1.3

concrete complex type

refers to a "complexType" element from the XML Schema Definition which usually extends an abstract complex type without being abstract itself

3.1.4

simple type

refers to a "simpleType" element from the XML Schema Definition

3.2 Abbreviated terms

FBD	function block diagram
IL	instruction list
LD	ladder diagram
PLC	programmable logic controller
POU	program organization unit
PADT	programming and debugging tool
SFC	sequential function chart
ST	structured text
URI	uniform resource identifier
URL	uniform resource locator
XML	eXtensible Markup Language