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INTERNATIONAL STANDARD

Industrial-process measurement and control – Data structures and elements in process equipment catalogues – Part 10: Lists of properties (LOPs) for industrial-process measurement and control for electronic data exchange – Fundamentals

IEC 61987-10:2009(E)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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INDUSTRIAL-PROCESS MEASUREMENT AND CONTROL – DATA STRUCTURES AND ELEMENTS IN PROCESS EQUIPMENT CATALOGUES –

Part 10: Lists of Properties (LOPs) for Industrial-Process Measurement and Control for Electronic Data Exchange – Fundamentals

FOREWORD

International Standard IEC 61987-10 has been prepared by subcommittee 65E: Devices and integration in enterprise systems, of IEC technical committee 65: Industrial-process measurement, controls and automation.

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

FDIS	Report on voting
65E/134/FDIS	65E/145/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.

This part of IEC 61987 has to be read in conjunction with IEC 61987-1.

A list of all parts in the IEC 61987 series, under the general titles *Industrial-process measurement and control structures and elements in process equipment catalogues*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The exchange of product data between companies, business systems, engineering tools and, in the future, control systems (electrical, measuring and control technology) can run smoothly only when both the information to be exchanged and the use of this information have been clearly defined.

In the past, requirements on process control devices and systems were specified by customers in various ways when suppliers or manufacturers were asked to quote for suitable equipment. The suppliers in their turn described the devices according to their own documentation schemes, often using different terms, structures and media (paper, databases, CDs, e-catalogues, etc.). The situation was similar in the planning and development process, with device information frequently being duplicated in a number of different information technology (IT) systems.

Any method that is capable of recording all existing information once only during the planning and ordering process and making it available for further processing gives all parties involved an opportunity to concentrate on the essentials. A precondition for this is the standardization of both the descriptions of the objects and the exchange of information.

IEC 61987-1 makes an important step towards this goal by defining a generic structure in which product features of industrial process measurement and control equipment with analogue or digital output can be arranged. This facilitates the understanding of product descriptions when they are transferred from one party to another. Part 1 of this series of standards applies to the production of catalogues of process measuring and control equipment in paper form supplied by the manufacturer of the product.

The objective of IEC 61987-10 is to make processes involving measuring and control devices more efficient. This means that in addition to the device catalogue data of IEC 61987-1, information on operational and environmental aspects of the device is required. These aspects should be described and expressed in a form that can also be exchanged electronically and handled automatically.

In IEC 61987-10, devices are specified by creating lists of properties (LOPs). The properties themselves are compiled into blocks that describe particular features of a device. By compiling blocks, it is possible to produce a list of properties that completely describe a particular device type or the surroundings in which the devices is or will be installed and operate.

This part of IEC 61987 deals with the following.

- It concerns both properties that may be used in an inquiry and a quotation. It also addresses detailed properties required for integration of a process control device in systems for other tasks, such as planning (for example in Computer Aided Engineering (CAE) systems), maintenance and Enterprise Resource Planning (ERP) systems.
- It provides a method for standardization that helps both suppliers and users of process control equipment and systems to optimize workflows, both within their own companies and in their exchanges with other companies. Depending on their role in the process, engineering, procurement and construction (EPC) contractors may be considered to be either users or suppliers.
- It ensures the clarity of the information provided, as the data and structures are described in unambiguous terms.

It should also be noted that the component data dictionary might also be used for other applications, for example the generation of parts lists. It is also possible to generate legacy specifications from the same source.

Layers of electronic date exchange

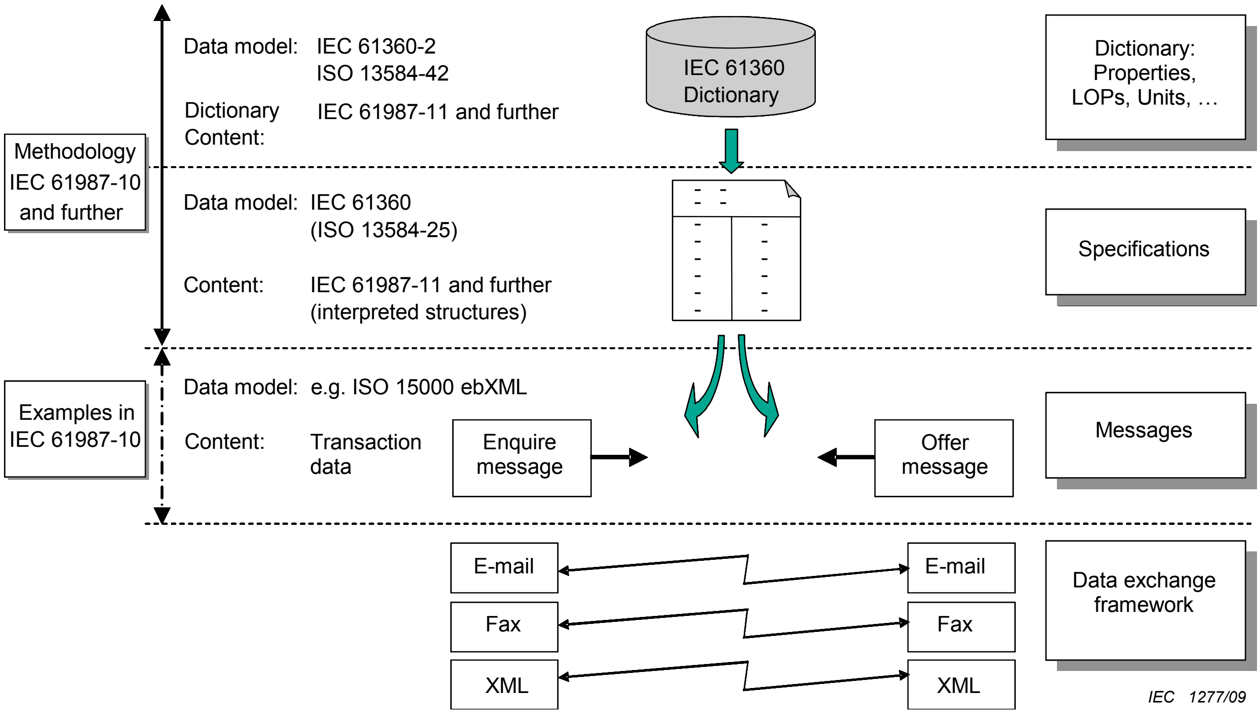

Figure 1 – Layers of electronic exchange procedures considered in this standard

The individual layers of data exchange considered in this part of IEC 61987 are described as follows (see also Figure 1).

Dictionary: To achieve standardized, distributed, common semantics of the devices, this standard describes a concept dictionary that captures terms, definitions and relationships of the devices. The basis is an IEC component data dictionary for industrial process measurement and control devices that uses the data models of IEC 61360-2 and ISO 13584-42. The dictionary content comprises the properties and blocks which will be defined in future IEC 61987-11, etc. The same standards also define lists of properties for process measurement and control devices.

NOTE 1 Not all devices will be included in the first edition of the dictionary, and it is possible that other devices will be added as new devices and technologies are developed.

Specifications: A process engineer planning a particular area in a plant uses an electronic specification sheet which draws its content from the component data dictionary. Similarly, a manufacturer quoting for an industrial process measuring device that fulfils the conditions defined in the specification sheet defines his device according to another specification sheet, which again draws its content from the component data dictionary. In interpretation of the specifications, the patterns of cardinality or polymorphism are evaluated.

Messages: Communication messages containing information about sender, receiver and transport protocol are generated from specifications.

NOTE 2 The generation of messages is not in the scope of this standard.

Data exchange framework: The messages are sent from one business partner to the other using data exchange frameworks. These can be conventional (e-mail, fax) using templates as described in Annex C of this standard, or XML message based distribution frameworks.

EXAMPLE: One example of a XML message distribution framework is ISO 15000 (ebXML).

The methodology to create these specifications and the description of the mechanisms that are required to compile meaningful data into such specifications are defined in this standard. Several aspects of the devices are also the subject of standardisation in this standard. For example, one aspect describes the operating environment at the installation point, that is the conditions under which a process measuring device must operate, and another describes the device specification which meets these conditions.

The properties contained in the component data dictionary however, may also serve other purposes, for example, the precise location of the production unit or control loop might form part of administrative and commercial exchanges. Similarly, more precise engineering data such as the designation of terminals or device calibration data might also be exchanged by means of additional specification sheets or by supplementing the device specification sheets.

Beyond the scope of this standard is the specification of transactional data required to exchange electronic specification sheets between companies, as shown in the messages layer of Figure 1. Similarly, no particular framework for data exchange is specified.

Each device type is defined by an LOP containing the properties that apply to it. This is a basic requirement for exchanging device information between different information technology (IT) systems.

The use of the LOPs therefore supports data exchange between systems in a business-to-business relationship and between systems within an organization, for example, CAE or ERP systems (see Figure 2). This standard also makes provision for the storage of device data as LOPs in process control systems or field devices.

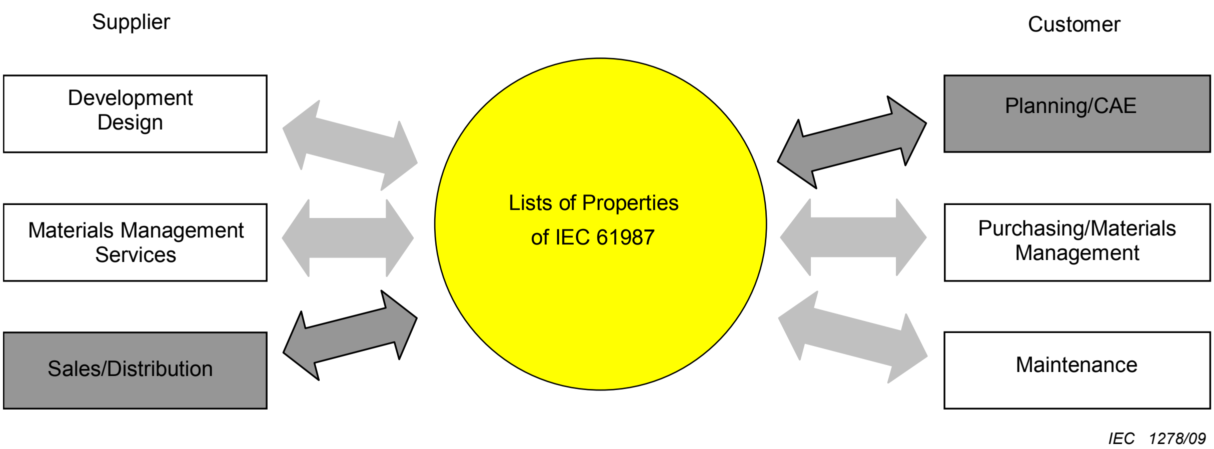

Figure 2 – Support for business-to-business relationships through the use of Lists of Properties

IEC 61987-10, IEC 61987-11 and further

IEC 61987-10 defines the approach for structuring lists of properties for electrical and process control equipment, for example measuring devices, actuators, motors, low-voltage switchgear, etc., in order to facilitate fully automatic engineering workflows in the planning and maintenance of industrial plants and to allow both the customers and the suppliers of the devices to optimize their processes and workflows.

Future IEC 61987-11 will contain lists of properties for measuring device types commonly used in the process industry.

Subsequent parts of IEC 61987 are already planned. These will contain lists of properties for other device families, such as actuators or signal conversion devices.

The properties themselves are to be found in the IEC Component Data Dictionary and follow the semantics and the structure of the IEC 61360 and ISO 13584 series of standards.

The concept of properties and structured lists is the subject of various standards. The data model described in the IEC 61360 and ISO 13584 series of standards is used in this standard. The structure defined for industrial-process measuring equipment in IEC 61987-1 is used, with some additions and modifications, to organise the contents of Device LOPs into blocks.

INDUSTRIAL-PROCESS MEASUREMENT AND CONTROL – DATA STRUCTURES AND ELEMENTS IN PROCESS EQUIPMENT CATALOGUES –

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1 Scope

This part of IEC 61987 provides a method of standardizing the descriptions of process control devices, instrumentation and auxiliary equipment as well as their operating environments and operating requirements (for example, measuring point specification data). The aims of this standard are

- to define a common language for customers and suppliers through the publication of Lists of Properties (LOPs),
- to optimize workflows between customers and suppliers as well as in processes such as engineering, development and purchasing within their own organizations,
- to reduce transaction costs.

The standard describes industrial-process device types and devices using structured lists of properties and makes the associated properties available in a component data dictionary.

The intention is to produce a reference dictionary which allows a description of the inquiry, offer, company internal and other descriptions of process control systems, instrumentation and auxiliary equipment based on list of properties.

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.

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
Amendment 1 (1999)

IEC 61346-1:1996, *Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations – Part 1: Basic rules*

IEC 61360 (all parts), *Standard data element types with associated classification scheme for electric components*

IEC 61360-1, *Standard data element types with associated classification scheme for electric components – Part 1: Definitions – Principles and methods*

IEC 61360-2, *Standard data element types with associated classification scheme for electric components – Part 2: EXPRESS dictionary schema*

IEC 61987-1, *Industrial-process measurement and control – Data structures and elements in process equipment catalogues – Part 1: Measuring equipment with analogue and digital output*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*

ISO 13584 (all parts), *Industrial automation systems and integration – Parts library*

ISO 13584-42, *Industrial automation systems and integration – Parts library – Part 42: Description methodology: Methodology for structuring part families*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1
administrative list of properties
ALOP
list of properties describing the aspect concerning initiating, tracking and completing a transaction

NOTE 1 The administrative list of properties contains, for example, information about the type of document (for example, inquiry, quotation) and the issuing details (for example, contact data of the author) and may be placed at the head of the transaction document.

NOTE 2 An ALOP may apply to a transaction of multiple instances of one or more device types, and will seldom be related to only a single device type.

3.1.2
aspect
specific way of selecting information on or describing a system or an object of a system

[IEC 61346-1, 3.3]

EXAMPLE: Such a way may be

- information about how to describe an object (device) – the describing aspect,
- information about the surrounding conditions in which a device operates – the operating aspect.

3.1.3
attribute
characteristic of an object or entity

[ISO/IEC 11179-1:2004, 3.1.1]

EXAMPLE: Properties, blocks, LOPs, units of measure etc. are entities.

3.1.4
block of properties
collection of properties relating to (describing) one concept of the device type being considered, for example device output, environmental conditions, operating conditions, device dimensions

NOTE 1 A block may also comprise other blocks of properties.

NOTE 2 A block of properties is a feature class in the sense of the series of standards IEC 61360 and ISO 13584.

3.1.5
cardinality
pattern defining the number of times a concept reoccurs within a description

NOTE 1 In IEC 61987-10 and future parts of IEC 61987, cardinality is used to indicate the repetition of blocks of properties or LOPs.

NOTE 2 In structural data cardinality defines the fact that the block may be repeated, whereas in transactional data the cardinality defines the number of times the block is repeated.

NOTE 3 Cardinality may be zero.

NOTE 4 Cardinality allows a block of properties contained in a list of properties to be used more than once for a particular transaction in order to describe, for example, a device with several different outputs or more then one process cases in describing the requirements for a device.

NOTE 5 Cardinality is mapped to IEC 61360 data model by means of a property that is placed directly before the block or property which can be repeated. The repeated block or property occurs in the structural data only once but in the transaction data as many times as the value of the cardinality property defines

3.1.6
characteristic
abstraction of a property of an object or of a set of objects

[ISO 1087-1:2000, 3.2.4]

NOTE 1 Characteristics are used for describing concepts.

NOTE 2 This standard uses properties to describe devices, their operating environment (ambient conditions) or other aspects.

3.1.7
commercial list of properties
CLOP
list of properties describing the aspect concerning business workflows

NOTE A commercial list of properties contains for example prices, costs, delivery times, transport information, and order or delivery quantity.

3.1.8
composite device
device composed of various devices

NOTE These devices might be supplied as a whole or the parts comprising the assembly of the composite device might be supplied individually.

EXAMPLE: A control valve which consists of the valve itself, a drive and a positioner.

3.1.9
concept
unit of knowledge described by a unique combination of characteristics

[ISO 1087-1:2000, 3.2.1, modified]

EXAMPLE: IEC 61987 subsumes LOP, blocks, properties, unit of measure, values etc. as concepts.

3.1.10
concept identifier
sequence of characters, capable of uniquely identifying that with which it is associated, within a specified context

[ISO/IEC 11179-1:2004, 3.1.3, modified]

NOTE This standard prefers the approach of IEC 61360-1 with a six-character code, which is unique for all concepts.

3.1.11
customer
organization or person that receives a product

EXAMPLE: Consumer, client, end-user, retailer, beneficiary and purchaser.

NOTE A customer can be internal or external to the organization.

[ISO 9000:2005, 3.3.5]

3.1.12
definition
representation of a concept by a descriptive statement which serves to differentiate it from related concepts

[ISO 1087-1:2000, 3.3.1]

3.1.13
device
material element or assembly of such elements intended to perform a required function

[IEC 60050-151, 151-11-20]

NOTE 1 A device may form part of a larger device.

NOTE 2 For measuring devices the identifier is the measuring principle, for actuators, the design/style and the operating principle.

NOTE 3 A List of Properties is defined for each device type, thus defining the structural data.

3.1.14
device list of properties
DLOP
list of properties describing a device

NOTE It may contain data relevant for CAE systems.

3.1.15
enumerated value domain
value domain that is specified by a list of all its permissible values

[ISO/IEC 11179-1:2004, 3.3.14]

3.1.16
list of properties
LOP
collection of properties applicable to a particular device type, its blocks and its aspects

NOTE 1 A list of properties, as defined in this standard, consists of blocks of properties.

NOTE 2 Lists of properties can be compiled for various aspects of a device type that are represented by different LOP types, for example, user requirements are part of the operating LOP, device description is the aim of the device LOP, commercial information is included in the commercial LOP, etc.

3.1.17
LOP type
list of properties concerning a device type describing one aspect of the device type

NOTE 1 Each aspect of a device is described by its own LOP type.

NOTE 2 LOP types of an LOP for a given device type create the first construction level of an LOP.

3.1.18
manufacturer
maker of the device (who may also be the supplier, the importer, or the agent) in whose name usually the certification, where appropriate, was originally registered

[IEC 60050-426, IEV 426-15-07, modified]

3.1.19
operating list of properties
OLOP
list of properties describing the aspect concerning the operational conditions of the device and additional information regarding its design

3.1.20
permissible value
expression of a value meaning allowed in a specific value domain

[ISO/IEC 11179-1:2004, 3.3.28]

3.1.21
polymorphism
pattern that allows substitution of a single concept in the same context by a different more specific (specialized) concept

NOTE 1 A specialised polymorphic block can replace a more generic one in the same context.

NOTE 2 A polymorphic operator (control property) can act in selecting between of various specialisations.

3.1.22
property
characteristic common to all members of an object class

[ISO/IEC 11179-1:2004, 3.3.29]

NOTE IEC 61987-10 uses object classes to indicate device types, types of operating environment or other aspects.

3.1.23
reference property
property that references a block of properties

NOTE 1 A reference property is a property with data type class_instance_type according to ISO 13584-42 and IEC 61360-2.

NOTE 2 Although reference properties are mandatory in the data model, it is not mandatory to show the reference property for all representations of devices. Sometimes it is sufficient to show the name of the referenced block only. For example the representation in Annex B shows only the referenced blocks.

3.1.24
supplier
organization or person that provides a product

EXAMPLE: Producer, distributor, retailer or vendor of a product, or provider of a service or information.

NOTE 1 A supplier can be internal or external to the organization.

NOTE 2 In a contractual situation, a supplier is sometimes called “contractor”.

[ISO 9000:2005, 3.3.6]

3.1.25
structural data
data that define the structure of a list of properties, that is, the specific properties and blocks of properties to be included in a list of properties and the way in which they are structured

NOTE Structural data can be represented as sheets for each device type and can be provided in PDF format, as an XLS worksheet or XML structure file.

3.1.26
transaction data
compilation of data containing device properties and their assigned values, as well as the block structure, as required for transfer from one system to another

NOTE 1 When the transaction data are transmitted, only those properties to which a value has been assigned in the structural data will actually be transferred.

NOTE 2 A property is represented in the transaction data normally by its ID code, the assigned value and unit of measure. These and other details depend on the schema used for data transfer.

3.1.27
value domain
set of permissible values

[ISO/IEC 11179-1:2004, 3.3.38]

3.1.28
value list
enumerated value domain

3.1.29
view
personalized subset of a list of properties for a device type

NOTE 1 Only those properties or blocks of properties that have been selected in the view for a given list of properties will actually be displayed.

NOTE 2 The transaction data are determined by the list of properties and not by the view.

3.2 Abbreviations

For the purposes of this standard, the following abbreviations apply.

ALOP	Administrative LOP
BSU	Basic Semantic Unit
CAE	Computer Aided Engineering
CLOP	Commercial LOP
DLOP	Device LOP
ERP	Enterprise Resource Planning
ILOP	Installation LOP
IT	Information Technology
LOP	List of Properties
MLOP	Maintenance LOP
P & ID	Piping and Instrumentation Diagram
OLOP	Operating LOP
SI	International System of Units (French: Système international d’unités)
UML	Unified Modelling Language
XML	Extensible Markup Language

4 Structural elements and concepts of lists of properties

4.1 General

A list of properties is a compilation of properties. Such a list may be structured or linear.

- A linear LOP has no explicit internal relationships. All the properties are arranged on one level, possess equal importance, and can be sorted according to any desired criteria.
- A structured LOP takes account of internal relationships. Properties are compiled into blocks of properties that describe a particular feature of an object.

Both types of LOPs are machine readable but the structured LOP has several important advantages especially if the number of properties of an LOP is large. The structured LOP in form of a list is considerably easier to read and analyse. A block of properties which describes a complex feature of an object can be handled similar to a single property. Once a block has been created, it can be introduced in more than one place of the same LOP representing features of the same type but not identical. The same block can be introduced in different LOPs concerning different device types.

4.2 Structural elements

4.2.1 Properties

4.2.1.1 Attributes of a property

Properties are specific features serving to describe objects, for example, process control devices. These features include requirements and boundary conditions, either imposed by the environment in which the device is to operate or which should be taken into consideration during operation. They also include all technical details of the device.

A property itself is defined by the attributes assigned to it, such as preferred name, definition, unit and format. The attributes are those specified in IEC 61360-2 and ISO 13584-42, for example

- code,
- version number,
- revision number,
- preferred name,
- preferred letter symbol,
- definition,
- source of the definition,
- note,
- remark,
- formula
- figure (if necessary),
- data type (instead of format),
- property type classification code,
- unit of measure,
- value list.

Figure 3 presents an example of attributes for a ‘Degree of protection of housing’.

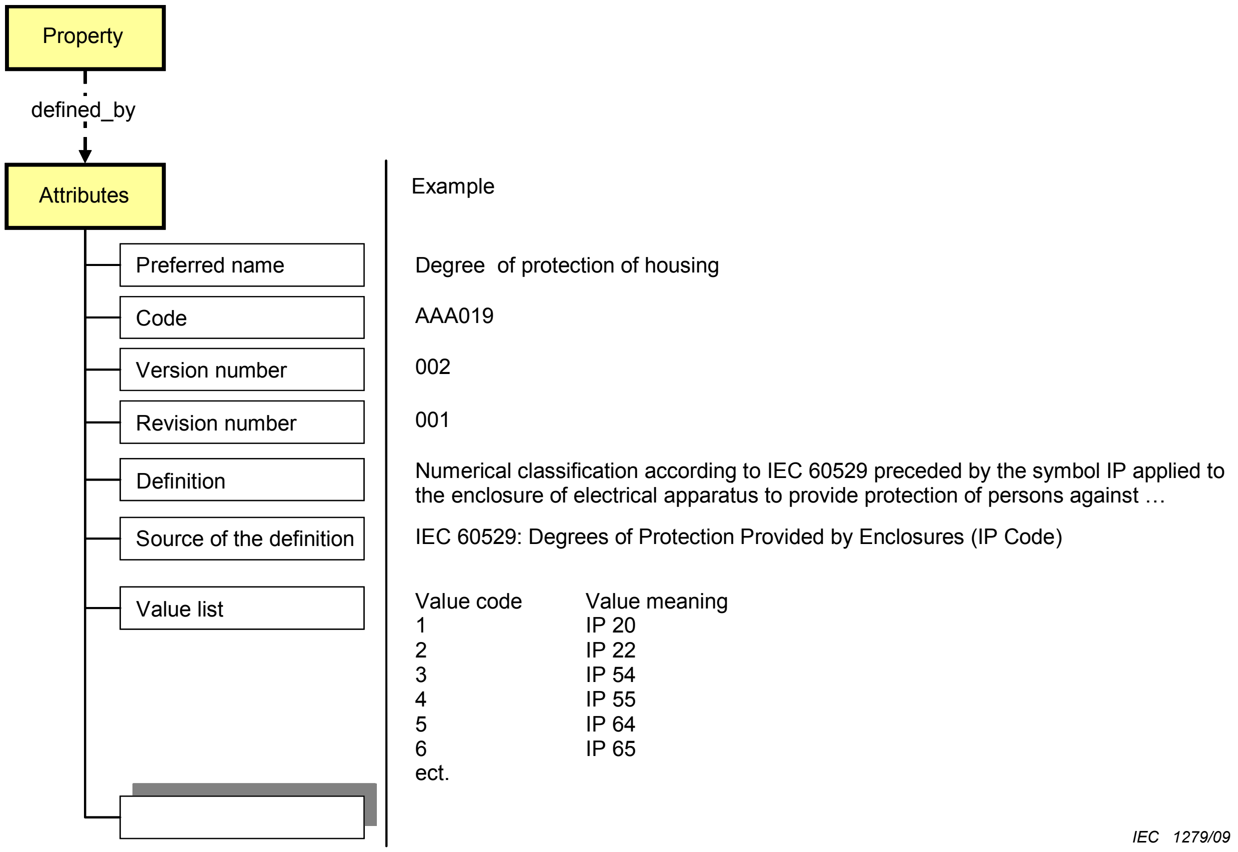

Figure 3 – A property and its attributes

4.2.1.2 Engineering units of measure

The engineering unit of measure is one of the most important attributes of a property representing a physical variable. For many countries it is sufficient to specify the use of SI units. Despite major efforts to achieve international standardization, however, the use of the SI system has not yet become established engineering practice throughout the world. In order to increase the acceptability of this series of standards and to ensure that data can be exchanged worldwide, this series of standards will specifiy a set of SI and non-SI units in future IEC 61987-11 and further parts that shall be used in data exchange. SI units are mainly defined in ISO 1000.

In some cases, for example, for measuring equipment, it is necessary to allow a set of units for one property. This standard specifies a list of allowable engineering units for each property including a “Default unit of measure”. Furthermore, the units are grouped according to scale.

NOTE In an engineering tool used to process LOPs in accordance with this standard, a unit selection list may be provided, allowing the engineer to select the correct unit for his specific application.

4.2.1.3 Property classification type

For engineering tasks it is important to be able to compare the values of quantitative properties representing the same physical variable. This need is met by the attribute “property type classification code” (short “type classification“). Its values are 3-character codes in accordance with IEC 61360-1 and ISO 13584-42. Only properties that have the same property type classification can be related to one another (compared, values added or subtracted).

NOTE An engineering tool can support this feature.

4.2.1.4 Value lists

It is helpful to be able to select the values to be assigned to the properties from value lists. This applies especially to properties for which standardized, alphanumerical expressions of value may exist.

NOTE This standard does not determine the number of values per property exchanged in the transactional data.

4.2.2 Blocks of properties

If all properties of a device type are arranged with equal importance on one single level, the list will become less understandable the more properties are added. Clarity can be achieved by structuring the properties in blocks.

A block of properties consists of one or more properties describing an abstraction of a feature of a device type. A block of properties may contain other blocks of properties nested to the necessary level as dictated by the technical requirements, see Figure 4. At the lowest level, a block will contain only properties. The block structure within the list of properties is illustrated by the Unified Modelling Language (UML) schema shown in A.1.1.

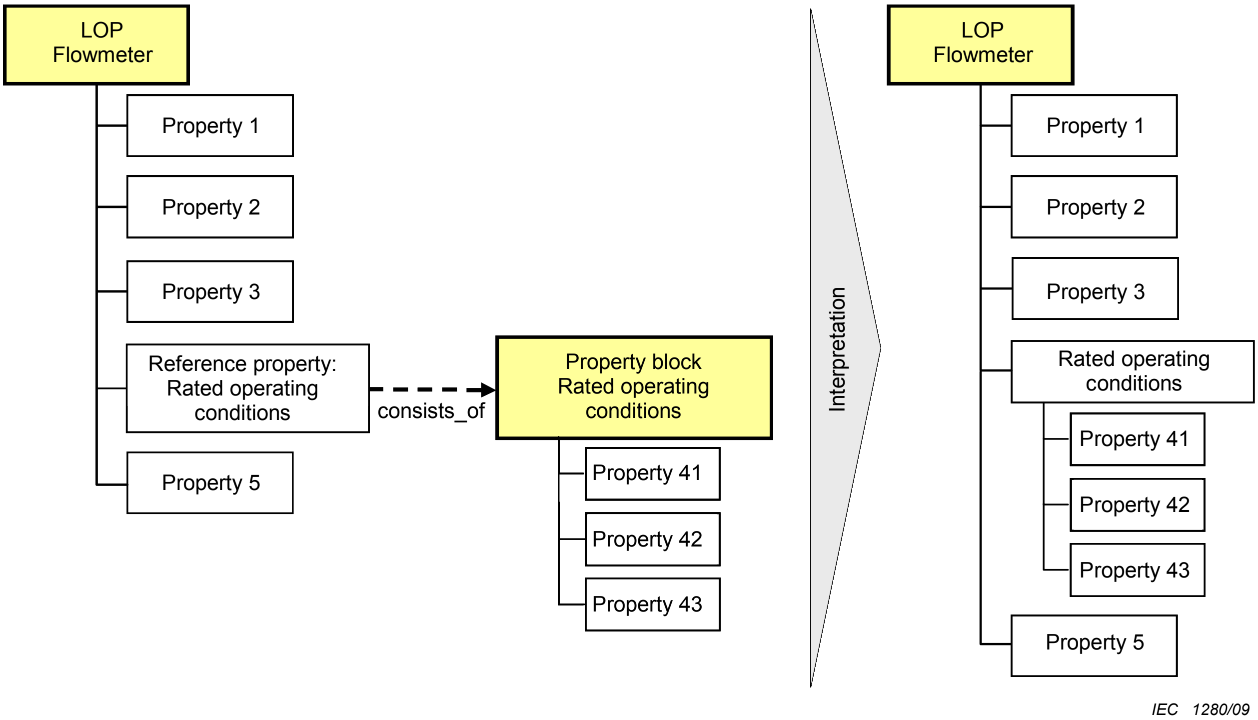

Figure 4 – Interpretation of a block of properties

If sub-blocks are present, a reference property is included in the higher-level block to refer to the respective sub-block and to fix the place where the sub-block should be introduced. In the case shown in Fig. 4, the reference property “Operating Conditions” refers to the property block with the same name. The reference property does not appear in the electronic specification sheet but is replaced by the block name.

Every block has a name and definition as per IEC 61360-2 and ISO 13584-42 but no value. Blocks are structured in a similar way to properties and have for example, following attributes:

- code;
- version number;
- revision number;

- preferred name;
- definition;
- note;
- remark;
- drawing reference;
- source of definition.

The block structure makes it easier to create new lists of properties. Once a block has been defined, it can be repeated at various points in the same list of properties. For example, an “Electrical Connection” block can be used in both analogue and binary output blocks.

The meaning of a property is determined by its definition, its relationship to other properties and the set of values assigned to it, provided a value list exists for it. Should it be necessary to assign different value lists to a property depending upon its position in a block or list of properties, separate properties shall be created by assigning unique codes.

NOTE There is no constraint the multiple use of property names.

4.2.3 Views

There is no necessity for the parties involved in a workflow to use all the properties defined for a particular device type. Frequently, it will be sufficient and more sensible to select only the data actually required for the purposes of viewing the device in a working context.

A view defines the particular set of properties required for example, for purchasing, planning or maintenance. Any application which uses LOPs must provide for a filter function allowing the selection of the appropriate data for that view from an LOP. A view enables the setting or cancelling a filter for properties and for blocks of properties.

NOTE Views can be defined as objects that are to be exchanged but separately from the transaction data.

4.3 Structural concepts

4.3.1 Cardinality

In addition to the block of properties as a structural element, various structural concepts are required in order to ensure highly flexible configuration of the structural data. This is necessary to achieve as realistic a description of the device and its operational environment as possible.

Cardinality allows a block of properties to be instantiated within a list of properties. Cardinality defines the relationship between a so-called cardinality property, the value of which determines how many times a block is be instantiated, and a reference property which refers to the block in question. The cardinality property has a name and definition as per IEC 61360-2 and ISO 13584-42 and a value.

In the example shown in Figure 5, the block “Line or equipment nozzle” contains a repeatable block “Line/nozzle”. The cardinality property is “Number of lines/nozzles”. Creating the description of a concrete object, the value assigned to the “Number of lines/nozzles” property has been set to “2”. As a result the “Line/nozzle” reference property together with the associated block of properties appears twice in the list of properties. By setting the value of the property “Line or nozzle role” to “Upstream” in the first block and “Downstream” in the second, the two lines or nozzles can be described.

The value of a cardinality property is a positive integer. If zero is entered, the block does not appear in the transaction data file (see Clause 6) of the list of properties.

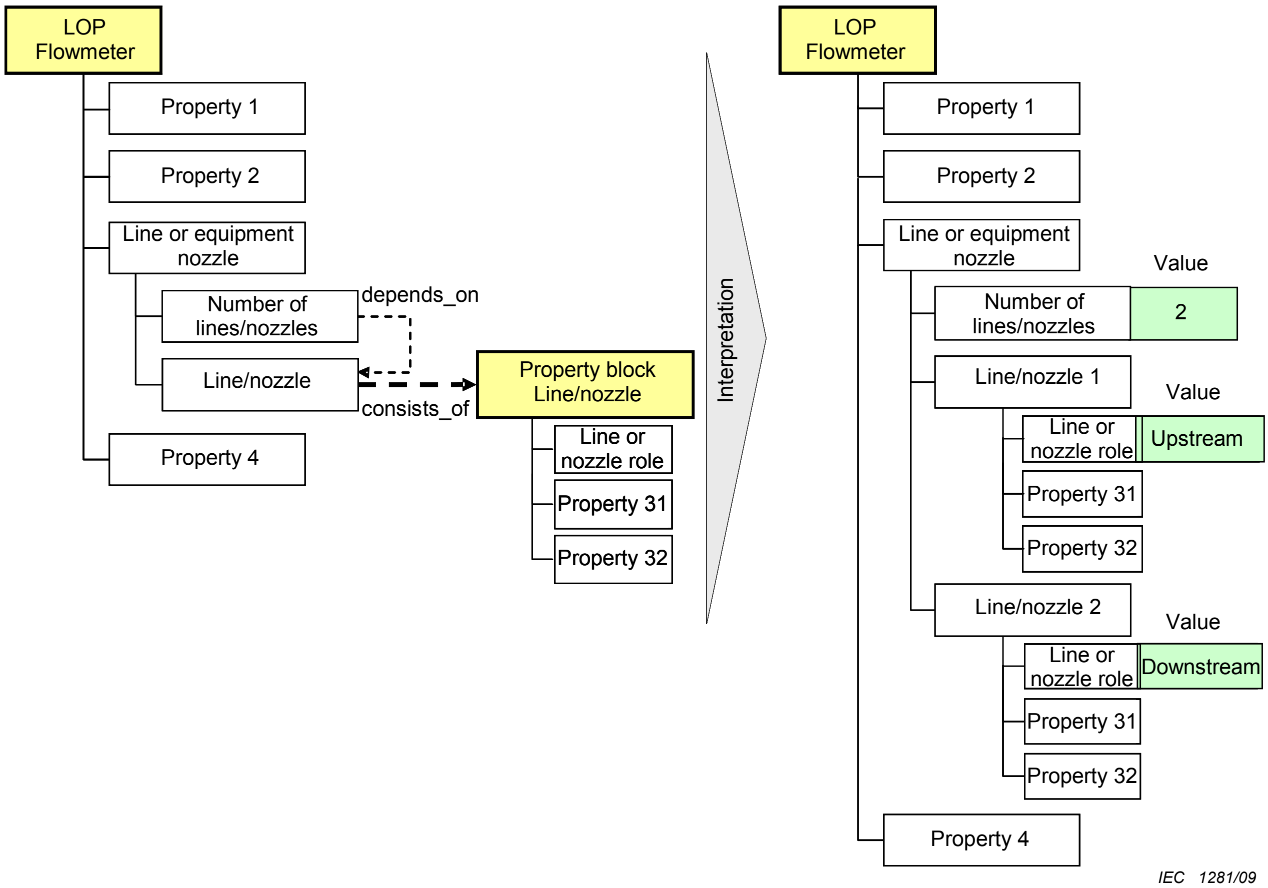

Figure 5 – Illustration of cardinality

4.3.2 Polymorphism

Polymorphism allows a specific block of properties to be selected from a collection of available blocks that describe variants of a particular aspect of the device. The block is selected by means of a value list in a so-called “control property”. The control property is part of a more generic block describing the same device aspect. In addition to the value list, the control property has a name and definition as per IEC 61360-2 and ISO 13584-42. This method allows blocks of properties describing specific device aspects to be grouped together.

In the example in Figure 6, the block of properties “Output” describes the signals provided by the device for transmission of the measured value to for example, a display, control system or other piece of control equipment. The block contains the control property “Output Type” as well as other blocks that are common to all output variants. The value list includes the variants “Current analog output”, “Binary output”, “Pulse output" and many more. In fact it contains all common outputs that might be found in an industrial process measurement device.

The properties contained in the “Output” block of properties are inherited by the variant blocks of properties. Every variant block of properties also contains additional properties that characterize the output in question.

When generating an electronic specification sheet (transaction data, see Clause 6), the specific type of output is selected by assigning a value to the control property in the “Output type” block. The selected block is then instantiated in the list of properties. The properties of the block may then be configured. The control property does not appear in the electronic specification sheet but is replaced by the block name of the value selected.

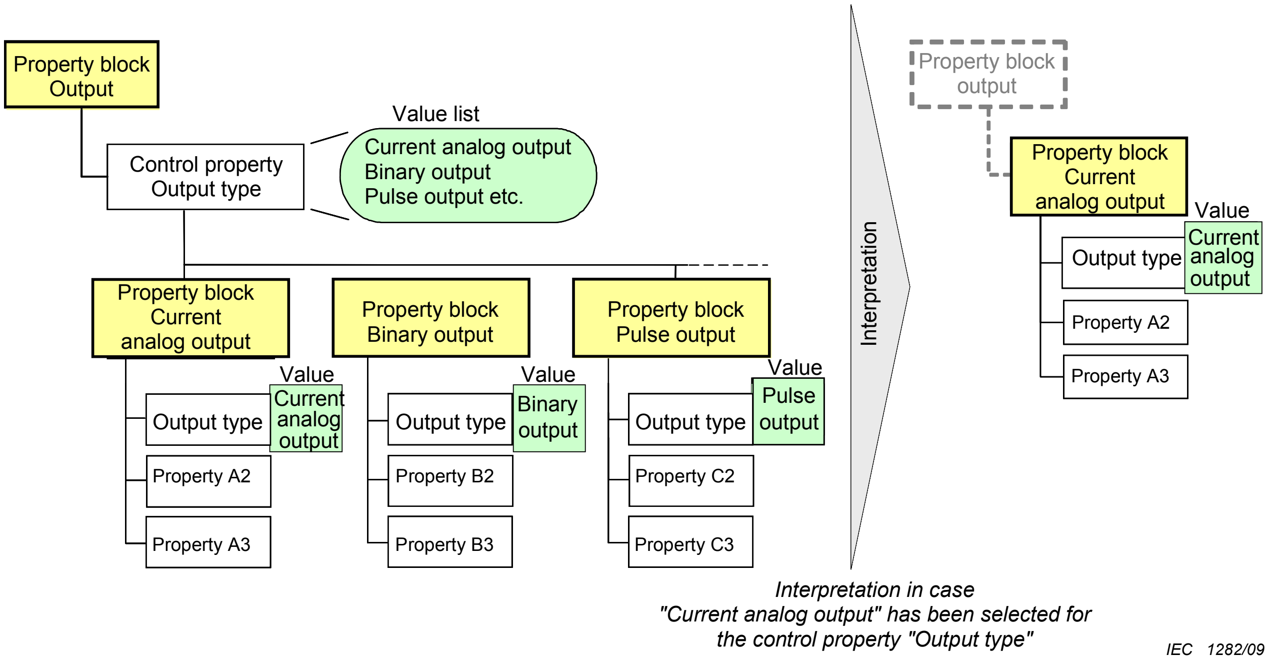

Figure 6 – Illustration of polymorphism

The block level represented by the “Output” block exists only in the structural data of the list of properties. It is not used in the transaction data (see Clause 6).

A prerequisite for polymorphism is that the block describing the more specific concept has at least the same properties as the generic concept. Properties used in the generic block “Output” are inherited into the blocks (”Current analog output”, “Binary output”, “Pulse output”) which are specializations of the block “Output”.

NOTE In Figure 6 the property “Output type” is shown twice. In fact, it is the same property, which is inherited from the block “Output” to the blocks ”Current analog output”, “Binary output”, “Pulse output”.

4.3.3 Composition/Aggregation

Composition/Aggregation describes the structure of composite devices.

Composition/Aggregation links lists of properties of a composite device together. It is realized by compiling lists of properties describing the various parts of the composite device under a surrounding list of properties.

Example: A control valve assembly, which comprises a valve drive and positioner and a temperature meter which comprises a thermowell, insert, extension and connection head.

Figure 7 shows an example of composition/aggregation, where the list of properties for a control valve is made up of the lists of properties for a valve, a drive and a positioner, all of which exist in their own right.

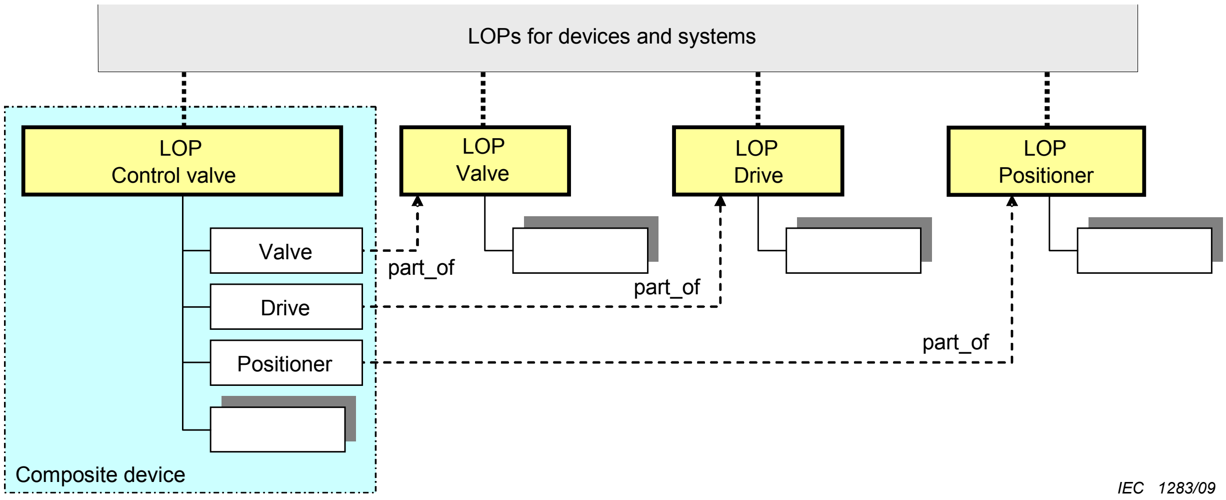

Figure 7 – Structure of a composite device

5 Types of Lists of Properties

5.1 General

Most of the classification systems that use lists of properties concentrate today exclusively on describing the technical features of a device. This standard, on the other hand, takes account of other aspects of a device type.

In this standard these aspects are depicted by using several different types of lists of properties. The technical features of the device are described in the Device List of Properties (DLOP) and the operating aspects, for example operating environment, are covered by the Operating List of Properties (OLOP). Other types of LOPs as the Administrative List of Properties (ALOP) and the Commercial List of Properties (CLOP) are considered. These lists of properties and their main content are explained below.

For creation of LOPs, the following rules apply.

a) An LOP assigned to a given device type is compiled from one or more types.

b) An LOP type represents one aspect of a device type (see also Clause A.1).

c) The LOP types create the first construction level of an LOP.

d) An LOP type consists of blocks; this is the second construction level of an LOP.

e) Blocks and properties occur in the second and the further construction levels of an LOP.

Every user of an LOP which is assigned to a given device type is allowed to implement in his process (engineering, maintenance, commercial, etc.) any LOP type that is useful to optimize the said process.

The use of these LOP types in an engineering workflow is explained in Clause C.1.

5.2 Administrative List of Properties (ALOP)

An Administrative List of Properties (ALOP) might contain information about the type of document (for example inquiry, offer), or the issuing details (for example contact data of the author) as well as customer's properties and organizational and administrative information required to process the inquiry. It also identifies the location of the device within the plant.

In a business process, it is normal that technical and business information is exchanged. The technical aspects are described in the Operating List of Properties and Device List of Properties. A number of standards exist for the exchange of business aspects. If there is no implementation of the transaction exchange for the business aspects, the Administrative List of Properties in B.1.1 can be used.

5.3 Operating List of Properties (OLOP)

An Operating List of Properties (OLOP) contains aspects relating to the operational environment of the device, device design requirements as well as all boundary conditions applicable to the point of operation.

The Operating List of Properties lies within scope of this standard. Future part 11 and further parts of IEC 61987 will specify OLOPs for various industrial-process measurement devices.

NOTE 1 An OLOP will normally comprise the basis of an inquiry.

NOTE 2 An OLOP may also capture properties that are used or are generated by a CAE system.

5.4 Device List of Properties (DLOP)

The Device List of Properties (DLOP) is used to describe the mechanical construction, the electrical construction and performance of a device.

The Device List of Properties lies within scope of this standard. Future IEC 61987-11 and further parts of IEC 61987 will specify DLOPs for various industrial-process measurement and control devices.

NOTE 1 A DLOP will normally comprise the basis of an offer or of a simple technical description but it may also form the basis of an inquiry.

NOTE 2 A DLOP may also capture properties that are used or are generated by a CAE system.

NOTE 3 A DLOP may be exchanged several times during a commercial transaction. At each stage additional properties will be filled out as the corresponding values become available.

Both the OLOP and DLOP draw their properties from the same component data dictionary. All properties have the same meaning, but it is quite possible that in a real application the same property in the OLOP and DLOP has a different value in each.

The OLOP defines for example the (full) line size upstream and downstream of the measuring or control point. However, the actual connection size of the measuring or control device is unknown until the supplier has sized the device. For control valves, many flow measuring devices, and almost all insertion type devices, the device connection size (reduced) is not necessarily equal to the OLOP line size. Therefore the nominal diameter value identified in the OLOP can be different from the device DLOP nominal diameter value.

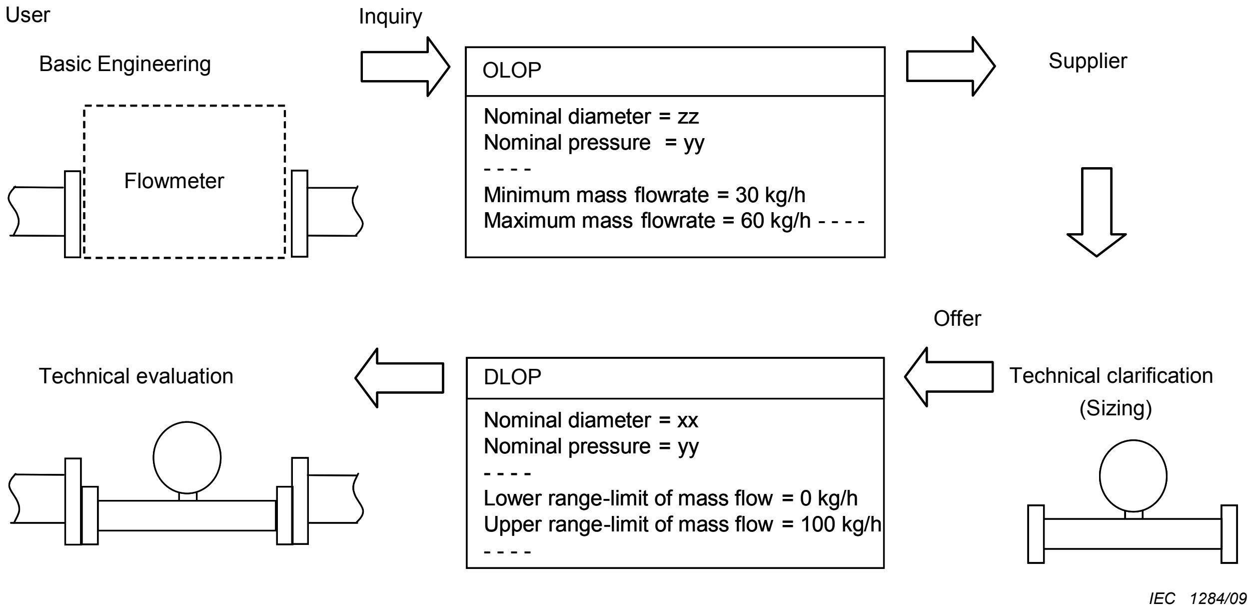

Figure 8 – Relationship between property values in the OLOP and DLOP

Figure 8 illustrates a case in point. In the basic engineering of a plant it is determined that a mass flowmeter is required. The pipeline has been designed at a nominal diameter of “zz” and for a nominal pressure of “yy”. The mass flow rate to be measured lies between 30 kg/h and 60 kg/h. An OLOP is generated on the basis of the design values and other environmental conditions and sent to a supplier as an inquiry.

On the supplier side, the inquiry enters technical clarification and a suitable flowmeter is selected and sized. In order to fulfil the technical requirements for measurement, the device offered has a different value for the nominal diameter “xx” than that in the OLOP. The measurement range and other values are also that of the flowmeter (0 kg/h to 100 kg/h) and not that of the OLOP. The device data are now used for generation of a DLOP that will be sent to the customer as an offer.

The customer now has the option of accepting the offer and redesigning the pipework around the flowmeter or looking for another supplier who can supply a flowmeter that fits it exactly.

5.5 Commercial List of Properties (CLOP)

A Commercial List of Properties contains commercial information such as prices, delivery times, transport information, and order or delivery quantity.

The Commercial List of Properties lies beyond the scope of this standard. Should it contain device properties, however, the specifications of this standard shall apply.

NOTE 1 The CLOP can play an important role in certain engineering workflows where not only technological properties but also commercial ones are considered.

NOTE 2 Several standardized methods of exchanging commercial data exist already, so that the CLOP will not be considered further in this standard.

5.6 Additional types of Lists of Properties

In addition to the LOP types mentioned above, other LOP types covering other important aspects of a device type considered in the engineering workflow, such as maintenance and installation, can be created, for example an MLOP (Maintenance LOP) and an ILOP (Installation LOP). This standard makes no restrictions on the creation of additional types of lists of properties other than that specifications of this standard shall apply to their structure and content.

5.7 LOP types for composite devices

When creating LOPs for composite devices, the following rule applies:

> An LOP type of a composite device shall be composed of corresponding LOP types of the devices of which the whole device comprises.

More detailed rules are not given here, as they wil be the subject of IEC 61987-11 and further parts of this series of standards, which will deal with LOPs for different device families.

6 Structural and Transaction Data

6.1 Concept Identifier

A natural language description of a product requires that a person (who understands natural language) utilizes knowledge of the language and knowledge of the thing being described to understand the description. The drawback of natural language product data encoding is that computers can not interpret such descriptions, since computers cannot understand natural language.

EXAMPLE
In natural language, an end connection of a nozzle may be described as follows: End connection in 316L stainless steel flange to DIN 2501, Form C; nominal diameter DN 25, nominal pressure PN 40, nozzle length 300 mm.

Sometimes human readable specification sheets (for example, PDF) name-value pairs are used for product description or product specification. Such sheets are usually monolingual, not necessarily localizable and if taken out of context, the names (terms) may be ambiguous. In fact each name implicitly represents a property.

EXAMPLE
In a human readable specification sheet, a process connection of a device fitting the nozzle might be described as follows: Process connection: Flange DN 25 / PN 40 Form C, DIN 2501 / 316L, length 300 mm.

Concept identifiers identify "concepts", such as blocks, properties or units of measure, which are described in detail in a reference dictionary. The concept identifier uniquely addresses descriptive information about the concept, such as concept name and definition. The information in the reference dictionary may be multilingual and even localized (country-specific, area-specific, but also market-specific or company-specific). Concept identifiers can be resolved to unambiguous, multilingual terminology or other information, such as the Unit of Measure assigned to a property, which provides the context for interpretation of the values used for description and transfer.

According to ISO 13584 and IEC 61360 basic semantic units (BSU) are assigned to dictionary elements, to provide an universally unique identification for dictionary descriptions. BSUs are machine interpretable concept identifiers and not intended for human usage.

This standard uses human readable concept identifiers, similar to ISO/TS 29002-5, which are simplified representations of BSUs. The prefix “IEC” denotes that a given concept is defined within the IEC component database.

A particular machine interpretable data exchange format shall define the exact representation of concept identifiers and shall not rely on the simplified human readable form used here.

Information in the example above can be unambiguously presented as shown in Table 1 using concept identifiers.

Table 1 – Example of concept Identifiers

Identifier	Name	Value
IEC-ABA437	Line/nozzle	–
IEC-ABA066	Nozzle length	300 mm
IEC-ABA394	End connection	–
IEC-ABA144	End connection type	Flange
IEC-ABA071	Nominal pressure	PN 40
IEC-ABA145	Nominal diameter	DN 25
IEC-ABA138	Face style	Form C
IEC-ABA263	Face finish	–
IEC-ABA156	Design code	DIN 2501
IEC-ABA167	Material of construction	Stainless Steel
IEC-ABA162	Material code	316L
IEC-ABA170	Reference standard for material code	AISI
IEC-ABA206	Gasket type	–
IEC-ABA253	Gasket nominal size	–
IEC-ABA044	Gasket material	–

NOTE 1 The properties “Line/nozzle” and “End connection” are block names and have no value.

NOTE 2 The values for the gasket properties might be filled in at a later date.

NOTE 3 Relationships might exist between concepts, which are also valuable to interpret the concept, like the temperature for the amplification factor in a semiconductor. Such relationships between concept identifiers can also be represented formally and unambiguously (see IEC 61630).

6.2 Structural Data

The purpose of the structures and structural elements (structural data) described in Clauses 4 and 5 is to allow the generation of lists of properties for different aspects of different types of devices and systems. These structural data describe the static modelling of the abstraction of the devices. They indicate the order of the properties in a block and the order and nesting of the blocks in a list of properties.

6.3 Transaction Data

When information describing one or more aspects of a device is to be transferred to another party, this is done by generating transaction data (or electronic specification sheet).

The purpose of transaction data is to allow transfer of the information from one computer system to another regardless of the language used by the respective computer systems. The receiving system uses the structural data to interpret the information received, i.e. to put the values in the appropriate context.

NOTE 1 The data format for transactional data has to be agreed upon various business partners (see example in Clause C.1).

When a concept identifier is perceived in transactional data there shall be a lookup mechanism to retrieve the full description of a concept out of structural data to enable its interpretation.

EXAMPLE: The length of a nozzle allowing the insertion into or attachment to the process.

Transactional Data

	IEC-ABA066	300	MMT

NOTE 2 "MMT" is the code of the unit of measure "mm" according to UN ECE code. This code has been used very often to code the unit of measure in the transaction data in order to make the content unambiguous.

Interpretation (en)

Nozzle length	IEC-ABA066	300	mm

Interpretation (fr)

Longueur de manchon	IEC-ABA066	300	mm

The example of natural language cited in 6.1 can be used to generate transaction data, as shown in Table 2.

Table 2 – Example of transaction data

Meaning	Transaction data		
Block ID of 1st block	IEC-ABA437		
Property ID, value of 1st property	IEC-ABA066	300	MMT
Block ID of 2nd block	IEC-ABA394		
Property ID, value of 1st property	IEC-ABA144	Flange	
Property ID, value of 2nd property	IEC-ABA071	PN 40	
Property ID, value of 3rd property	IEC-ABA145	DN 25	
Property ID, value of 4th property	IEC-ABA138	Form C	
Property ID, value of 5th property	IEC-ABA263		
Property ID, value of 6th property	IEC-ABA156	DIN 2501	
Property ID, value of 7th property	IEC-ABA167	Stainless Steel	
Property ID, value of 8th property	IEC-ABA162	316L	
Property ID, value of 9th property	IEC-ABA170	AISI	
Property ID, value of 10th property	IEC-ABA206		
Property ID, value of 11th property	IEC-ABA253		
Property ID, value of 12th property	IEC-ABA044		
NOTE Only the first property of the first block has a unit of measure in this example.			

The individual properties are normally represented exclusively by a globally unique identifier and the value assigned to that identifier. For properties with a unit of measure, the unit used is added to the value of the property. The property domain (for example: integer number, real number, text, etc.) is defined in the structural data of the properties. Any value assigned to the property must be of the corresponding property domain.

For properties for which the structural data defines a value list, one or more values can be transmitted.

Subject to the implementation and the chosen data format, value lists might be "non-validated", that is any desired value can be transferred, or "validated", that is the value must be selected from the associated value list and no other value is allowed. If more than one value is allowed for a specific property, two or more values from the value list for that property can appear in the transaction data.

A complete list of properties is also identified by one single, unique identifier.

EXAMPLE: Coriolis mass flowmeter is identified by IEC-ABA442

Coriolis mass flowmeter	IEC-ABA442

A block which is contained in a list of properties is represented by a reference property defining its context as well as by its own identifier. For another example see Annex B.1.1)

EXAMPLE: End connection properties

Block name = name of the reference property	Reference property identifier	Block identifier
End connection	IEC-ABA237	IEC-ABA394

According to the value entered in its associated cardinality property, a block is repeated for a specific number of times. If the value of the cardinality property is zero, the block will be omitted.

The control properties of the polymorphism function can also contain values. A block is linked to the control property via its class constant value. The control property defines the chosen block. When this has been done, none of the other blocks in that polymorphic set will appear in the transaction data.

The transaction data are interpreted (for example, for visualization purposes) using the structural data. This is illustrated in Table 3 for the example described above.

Clause C.1 shows a further example for the transition from structural to transaction data.

The distinction made between structural data and transaction data is a key element in the handling of lists of properties. In this standard, however, it serves only to describe the conceptual background and no attempt will be made to describe the methodology in detail.

As there are features in operational data or in device data which can only be expressed as figures, formulas or charts, the use of a transaction file format that allows the assigning of document attachments to transaction messages containing an LOP is recommended

Although this standard does not specify any preferred method for transferring the structural data and the transaction data (messages) from one party to another, it should be mentioned here that the experience gained to date in the operational use of the LOP technology definitely shows that the most convenient method for this is XML. As XML is ideal for data exchange between two computer systems, messages exchanged according to this standard can be easily generated and analysed by computers, which is the original intention behind the introduction of the LOP technology.

Table 3 – Example of visualisation of the transaction data

LOP ID	IEC-ABA437				
LOP name (en)	Line/nozzle				
LOP name (de)	Rohr/Stutzen				
Property identifier	**Name (en)**	**Name (de)**	**Value**	**Unit**	**Unit identifier**
IEC-ABA066	Nozzle length	Stutzenlänge	300	mm	MMT
LOP ID	IEC-ABA394				
LOP name (en)	End connection				
LOP name (de)	Prozessanschluss				
Property identifier	**Name (en)**	**Name (de)**	**Value**	**Unit**	**Unit identifier**
IEC-ABA144	End Connection type	Anschlussart	Flange		
IEC-ABA071	Nominal pressure	Druckstufe	PN 40		
IEC-ABA145	Nominal diameter	Nennweite	DN 25		
IEC-ABA138	Face style	Bauform Dichtfläche	Form C		
IEC-ABA263	Face finish	Dichtflächen-behandlung			
IEC-ABA156	Design code	Bauform Bezugsnorm	DIN 2501		
IEC-ABA167	Material of construction	Werkstoff Bezeichnung	Stainless Steel		
IEC-ABA162	Material code	Werkstoff Nummer	316L		
IEC-ABA170	Reference standard for material code	Werkstoff Bezugsnorm	AISI		
IEC-ABA206	Gasket type	Dichtungstyp			
IEC-ABA253	Gasket nominal size	Dichtung Nennweite			
IEC-ABA044	Gasket material	Dichtung Prozessanschluss			

Annex A
(normative)

Conceptual model of a List of Properties

A.1 Schemes for the Structure of Lists of Properties

A.1.1 Structure of the Lists of Properties

Figure A.1 shows the Unified Modelling Language (UML) structure of the LOPs described in this standard.

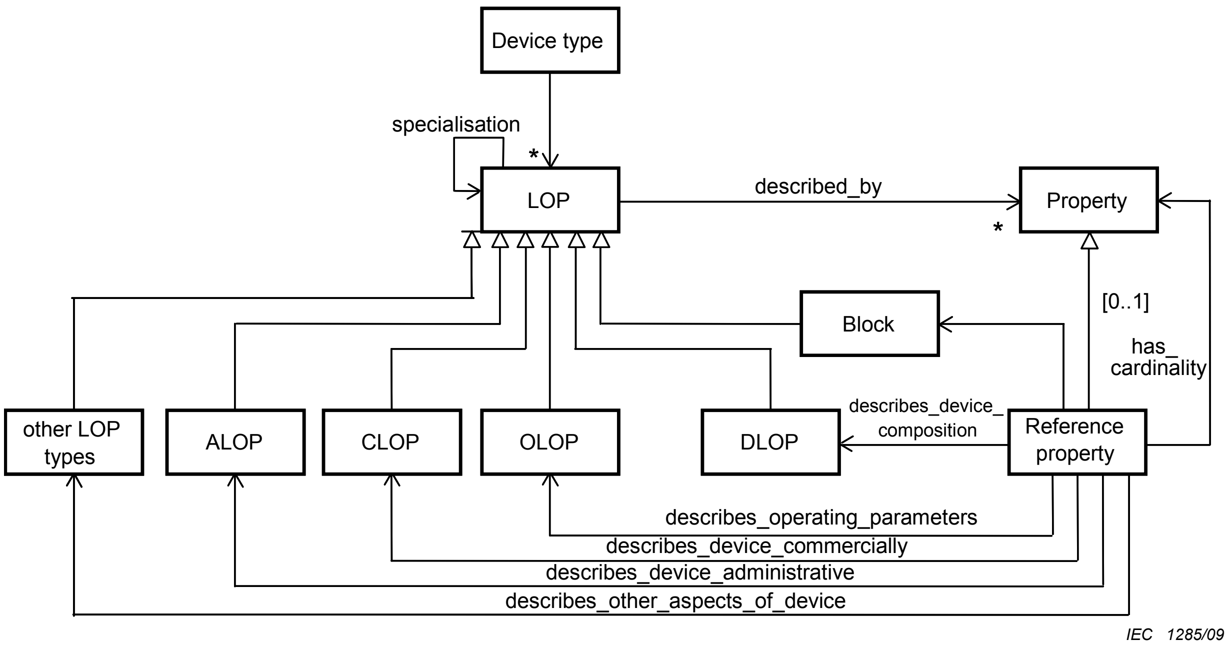

Figure A.1 – Simplified UML scheme of an LOP

A.1.2 Conceptual UML scheme of the data model

A.1.2.1 General

The UML model in this chapter is not intended to be used for a practical implementation (for example, database). It has the goal to explain the conceptual relationships between the different major entities.

The main entities and relations of ISO 13584-42 and IEC 61360-2 are contained in UML diagram in Fig. A2 which was published as part of the CEN / ISSS CEN Workshop agreement (CWA) 15295.

The individual relationships illustrated in Figure A.2 are explained below.

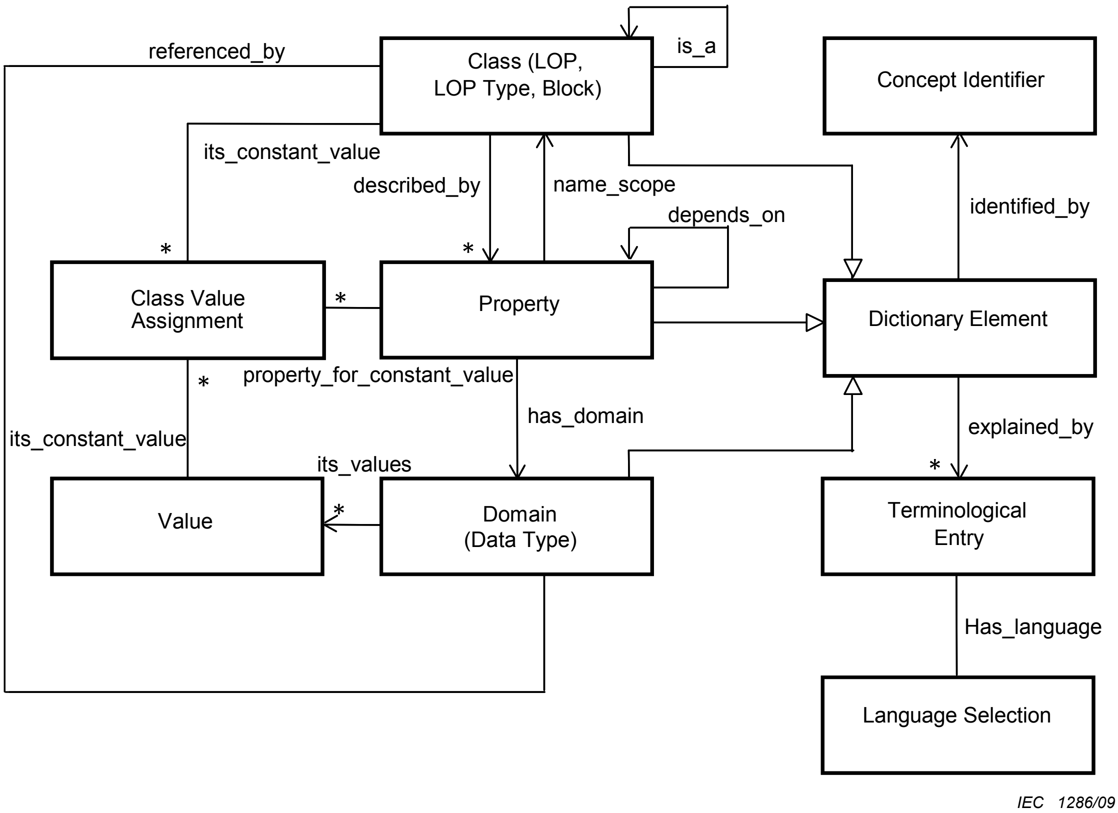

Figure A.2 – Conceptual UML scheme of the data model

A.1.2.2 Unique identification of each property (class)

Each dictionary element (e.g. property) has an associated language-independent concept identifier which is uniquely defined worldwide and includes the source (originator) of said dictionary element.

This relationship of dictionary element to concept identifer is designated as "*identified_by*".

A.1.2.3 Terminological entries of each dictionary element

Each dictionary element is described by terminological entries, such as its name, definition, etc. This relationship is designated as "*explained_by*".

A.1.2.4 Language selection of terminological entry

Each terminological entry is assigned one language selection.

This relationship is designated as "*has_language*".

A.1.2.5 Definition scope of a property

To arrive at a semantically clear meaning for each property it is necessary to define exactly one definition scope for a property. This relationship is called "*name_scope*".

In the context of this recommendation, all properties, all device types (lists of properties/LOPs) and all blocks have the same scope.

A.1.2.6 Property application in a class

Property application is the process of using well-defined properties in a class (LOP, LOP type or block). The relationship between a device type (LOP), an LOP type or a block and the set of actual properties is called "*described_by*".

A.1.2.7 Abstraction by use of generic classes

The concept of generalization/specialization is used to express the fact that a particular block is a specialized meaning of a more generic block and has a more specialized definition or has additional properties or features. The relationship between a specialized class and a generic class is called "*is_a*".

NOTE 1 The generalization/specialization is the basis for polymorphism. Polymorphism works on the principle that each statement that applies to a given abstraction must also apply to all specializations of that abstraction.

NOTE 2 This approach leads to a tree, where each node represents an abstraction, while the child nodes are subsets of this abstraction. This hierarchy tree should not be confused with the hierarchical structure of classification systems.

A.1.2.8 Domain for properties

To improve the semantics, properties may be assigned an explicit domain, for example,a data type such as number, Boolean, etc. which describes the set of permissible values.

The domain is a description of the set of permissible values for a property.

The relationship between a property and its domain is called "*has_domain*".

A.1.2.9 Permissible values for the domain of a property

The semantics of a domain of a property can be further enriched if the property has a set of permissible values in an enumerated description. This set of permissible values is called a list of values.

The relation between a property and its enumerated set of values is called "*its_values*".

A.1.2.10 Properties expressing composition/aggregation

For composite devices there is a need to define how they are put together. In this case an LOP will contain a "reference property" which refers either to an LOP (composition/aggregation) or a block (feature abstraction).

The reference property points to a class (LOP or block). Thus the property has a different data type "reference" which expresses the fact, that the domain is the set of objects described by the LOP or block.

The relation between a reference property and referenced class is called "*referenced_by*".

In Figure A.2, the relationship *referenced_by* is interpreted either as a *part_of relationship* for modelling product composition, or as a *consists_of* relationship for modelling feature abstraction.

A.1.2.11 Property depending on property

A property can depend on a property, which controls the said property.

The relationship is called "*depends_on*".

NOTE Property dependency is the basis for cardinality. For cardinality, a property with domain of a set of reference properties, is dependent on the control property which controls how many reference properties shall be instantiated in the set.

A.1.2.12 Class value assignment

Some properties may have constant values if used in a particular class.

This relationship between class value assignment and value is called "*its_contstant_value*".

The relationship between class value assignment and property is called "*property_for_constant_value*".

The relationship between class and class value assignment is called "*its_constant_value*".

NOTE Class value assignment is the basis for polymorphism. Polymorphism works on the principle that for a given list of values, for each value a specialization of a block exists, which has a matching class value assignment. This structure allows, on selection of a value out of the list of values, a matching specialized block to be found, which substitutes the more generic block in the context of the value selection.

A.1.2.13 Distinguishing a general model from a functional model

A particular measuring device is modelled using different LOP types. In the terminology of ISO 13584 these different LOP types, which do not always describe the product itself, but rather something which is applied to the product (for example the requirements for a product), are collectively called a functional model.

Functional models prevent the compilation of long lists of properties that are difficult to search and use. They help each part of the supply chain to quickly find its own property list.

Annex B
(informative)

Usage of LOPs

B.1 Example of Lists of Properties

B.1.1 General

To give a better understanding of the lists of properties of this standard, with their structural elements such as block, cardinality and polymorphism, two examples are presented below. The block names are given in bold.

B.1.2 Suggestion for an Administrative LOP

Table B.1 is a suggestion for an Administrative Block of Properties with a block structure combined with cardinalities. Table B.1 shows the structural data of the LOP.

In the line where a block occurs, the property identifier belongs to the reference property that references to the block. If the block is preceded by a cardinality property, the block will be repeated in the transactional data as many times as the value of the cardinality property (shown as Block (R) in the table).

Table B.1 – Suggestion for an Administrative List of Properties

Name of LOP type, block or property	*Representation of the line (object)*	*Property identifier*	*Block identifier*
View of the equipment with all properties			
Administrative list of properties	LOP type		IEC-ABA439
Document information	Ref. property + Block	IEC-ABA294	IEC-ABA362
Document identifier	Property	IEC-ABA164	
Document version	Property	IEC-ABA168	
Document revision	Property	IEC-ABA113	
Document type	Property	IEC-ABA274	
Date of generation	Property	IEC-ABA272	
Time of generation	Property	IEC-ABA285	
Author	Property	IEC-ABA087	
Document designation	Property	IEC-ABA079	
Document description	Property	IEC-ABA121	
Language	Property	IEC-ABA152	
Remark	Property	IEC-ABA126	
Project information	Ref. property + Block	IEC-ABA104	IEC-ABA398
Project number	Property	IEC-ABA309	
Subproject number	Property	IEC-ABA210	
Project title	Property	IEC-ABA218	
Enterprise	Property	IEC-ABA264	
Site	Property	IEC-ABA245	
Area	Property	IEC-ABA188	
Plant	Property	IEC-ABA196	
Unit	Property	IEC-ABA011	
Equipment	Ref. property + Block	IEC-ABA015	IEC-ABA426
Related equipment identifier	Property	IEC-ABA053	
Related equipment designation	Property	IEC-ABA099	
Service description	Property	IEC-ABA072	

Name of LOP type, block or property	*Representation of the line (object)*	*Property identifier*	*Block identifier*
Device	Ref. property + Block	IEC-ABA247	IEC-ABA441
Device identification code	Property	IEC-ABA038	
Device designation	Property	IEC-ABA251	
Device service description	Property	IEC-ABA252	
PCE identification / tag name	Property	IEC-ABA305	
PCE category and function	Property	IEC-ABA321	
PCE description	Property	IEC-ABA447	
Process Flow Diagram / Reference document	Property	IEC-ABA249	
Piping & instrument diagram / reference document	Property	IEC-ABA186	
Number of parties	Cardinality property	IEC-ABA204	
Party	Ref. property + Block (R)	IEC-ABA212	IEC-ABA372
Party role	Property	IEC-ABA276	
Party identifier	Ref. property + Block	IEC-ABA303	IEC-ABA379
Party number	Property	IEC-ABA229	
Party number type	Property	IEC-ABA242	
Address	Ref. property + Block	IEC-ABA355	IEC-AAA091
Address 1	Property	IEC-ABA346	
Address 2	Property	IEC-ABA341	
Address 3	Property	IEC-ABA314	
Department	Property	IEC-ABA073	
Street	Property	IEC-ABA286	
Zip	Property	IEC-ABA281	
Box number	Property	IEC-ABA295	
Zip box number	Property	IEC-ABA142	
City /town	Property	IEC-ABA129	
State	Property	IEC-ABA134	
Country	Property	IEC-ABA092	
VAT number	Property	IEC-ABA028	
Number of phone numbers	Cardinality property	IEC-ABA148	
Phone	Ref. property + Block (R)	IEC-ABA153	IEC-ABA399
Phone number	Property	IEC-ABA160	
Phone number type	Property	IEC-ABA086	
Number of fax numbers	Cardinality property	IEC-ABA082	
Fax	Ref. property + Block (R)	IEC-ABA050	IEC-ABA436
Fax number	Property	IEC-ABA069	
Fax number type	Property	IEC-ABA021	
URL	Property	IEC-ABA017	
Number of e-mail addresses	Cardinality property	IEC-ABA033	
E-mail	Ref. property + Block (R)	IEC-ABA036	IEC-ABA395
E-mail address	Property	IEC-ABA045	
E-mail type	Property	IEC-ABA004	
Public key	Property	IEC-ABA030	
Public key type	Property	IEC-ABA056	
Address remarks	Property	IEC-ABA064	
Number of contacts	Cardinality property	IEC-ABA068	
Contact information	Ref. property + Block (R)	IEC-ABA090	IEC-AAA097
Contact role	Property	IEC-ABA173	
Contact name	Property	IEC-ABA105	
First name	Property	IEC-ABA130	
Middle names	Property	IEC-ABA102	
Title	Property	IEC-ABA002	
Academic title	Property	IEC-ABA171	
Contact description	Property	IEC-ABA012	

Name of LOP type, block or property	*Representation of the line (object)*	*Property identifier*	*Block identifier*
Number of phone numbers	Cardinality property	IEC-ABA148	
Phone	Ref. property + Block (R)	IEC-ABA153	IEC-ABA399
Phone number	Property	IEC-ABA160	
Phone number type	Property	IEC-ABA086	
Number of fax numbers	Cardinality property	IEC-ABA082	
Fax	Ref. property + Block (R)	IEC-ABA050	IEC-ABA436
Fax number	Property	IEC-ABA069	
Fax number type	Property	IEC-ABA021	
URL	Property	IEC-ABA017	
Number of e-mail addresses	Cardinality property	IEC-ABA033	
E-mail	Ref. property + Block (R)	IEC-ABA036	IEC-ABA395
E-mail address	Property	IEC-ABA045	
E-mail type	Property	IEC-ABA004	
Public key	Property	IEC-ABA030	
Public key type	Property	IEC-ABA056	
Number of attachments	Cardinality property	IEC-ABA027	
Attachment	Ref. property + Block (R)	IEC-ABA296	IEC-ABA396
Language	Property	IEC-ABA152	
Place	Property	IEC-ABA325	
Container	Property	IEC-ABA349	
Mime type	Property	IEC-ABA312	
Source	Property	IEC-ABA052	
Description	Property	IEC-ABA298	
Alternative text	Property	IEC-ABA329	
Purpose	Property	IEC-ABA333	
Additional information	Ref. property + Block	IEC-ABA259	IEC-AAA099
Partial shipment allowed	Property	IEC-ABA238	
Remark	Property	IEC-ABA126	

B.1.3 Example of a part of an Operating LOP

Table B.2 shows an extract from the Operating List of Properties for the flowmeter. The extract has been generated by creation of an appropriate view of a flowmeter OLOP. Each view must have a name. In the example shown, the name is “IEC view”. As OLOPs of concrete device types will be published in IEC 61987-11 and subsequent parts, the property and block identifiers are not shown here.

Table B.2 – Example of Operating List of Properties

Name of LOP type, block or property	*Representation of the line (object)*
Equipment listing restricted by the IEC view	
Operating list of properties of flowmeter	LOP type
Administrative information	Ref. property + Block
Document information	Ref. property + Block
Document identifier	Property
Document type	Property
Document version	Property
Document revision	Property
Date of generation	Property
Author	Property
Remark	Property
Project information	Ref. property + Block
Project number	Property
Number of devices	Cardinality property
Device	Ref. property + Block (R)
PCE identification/tag name	Property
Base conditions	Ref. property + Block
Absolute base pressure	Property
Base temperature	Property
Number of process cases	Cardinality property
Process case	Ref. property + Block (R)
Process case designation	Property
Process case variables	Ref. property + Block
Total fluid	Ref. property + Block
Fluid designation	Property
Mass flow rate	Property
Normalized volumetric flow rate	Property
Absolute pressure	Property
Temperature	Property
Operating conditions for device design	Ref. property + Block
Process design conditions	Ref. property + Block
Normal process design conditions	Ref. property + Block
Minimum mass flowrate	Property
Minimum normalized volumetric flowrate	Property
Maximum mass flowrate	Property
Maximum normalized volumetric flowrate	Property
Safety design conditions	Ref. property + Block
Number of design deratings	Cardinality property
Design deratings	Ref. property + Block (R)
Maximum design absolute pressure	Property
Maximum design temperature	Property
Line or equipment nozzle	Ref. property + Block
Number of lines/nozzles	Cardinality property
Line/nozzle	Ref. property + Block (R)
Line or nozzle role	Property
Nominal pressure	Property
Nominal diameter	Property
End connection	Ref. property + Block
End connection type	Property
Nominal pressure	Property
Nominal diameter	Property
Face style	Property
Face finish	Property

Name of LOP type, block or property	*Representation of the line (object)*
Design code	Property
Material of construction	Property
Material code	Property
Reference standard for material code	Property
Number of physical locations	Cardinality property
Physical location	Ref. property + Block (R)
Physical location designation	Property
PCE identification	Property
Number of indoor/Outdoor local area classifications	Property
Indoor/Outdoor local area classification	Ref. property + Block
Zone	Property
Equipment protection level	Property
Class	Property
Division	Property
Group	Property
Temperature class	Property
Area classification reference standard	Property

B.1.4 Example of a part of an Device LOP

Table B.3 shows an extract from the Device List of Properties for a flowmeter. The extract has been generated by creation of an appropriate view to the flowmeter DLOP. Each view must have a name. In the example shown, the name is "IEC view". As DLOPs of concrete device types will be published in IEC 61987-11 and subsequent parts, the property and block identifiers are not shown here.

Table B.3 – Example of Device List of Properties

Name of LOP type, block or property	*Representation of the line (object)*
Equipment listing restricted by the IEC view	
Operating list of properties of flowmeter	LOP type
Administrative information	Ref. property + Block
Document information	Ref. property + Block
Document identifier	Property
Document type	Property
Document version	Property
Document revision	Property
Date of generation	Property
Author	Property
Remark	Property
Project information	Ref. property + Block
Project number	Property
Number of devices	Cardinality property
Device 1	Ref. property + Block (R)
PCE identification/tag name	Property
Device data	Ref. property + Block
Identification	Ref. property + Block
Manufacturer name	Property
Manufacturer product type	Property
Manufacturer product code	Property
Input	Ref. property + Block
Number of measured variables	Cardinality property
Measured variable	Ref. property + Block (R)
PCE identification	Property

Name of LOP type, block or property	***Representation of the line (object)***
Measured variable type	Property
Mass flow measurement	Ref. property + Block
Measuring range	Ref. property + Block
Mass flow lower range-limit	Property
Mass flow upper range-limit	Property
Number of outputs	Cardinality property
Output	Ref. property + Block (R)
PCE identification	Property
Output type	Control property
Current analog output	Ref. property + Block
Analog signal configuration	Ref. property + Block
Assigned variable type	Property
Assigned mass flow range	Ref. property + Block
Mass flow lower range-value	Property
Mass flow upper range-value	Property
Current analog output parameters	Ref. property + Block
Current output lower range-value	Property
Current output upper range-value	Property
Performance properties	Ref. property + Block
Number of performance variables	Cardinality property
Performance variable	Ref. property + Block (R)
PCE identification	Property
Performance variable type	Property
Mass flow performance	Ref. property + Block
Mass flow measuring accuracy	Ref. property + Block
Mass flow measured error	Ref. property + Block
Mass flow maximum measured error	Property
Rated Operating Conditions	Ref. property + Block
Process conditions	Ref. property + Block
Process design safety conditions	Ref. property + Block
Nominal pressure	Property
Operating design conditions	Ref. property + Block
Maximum operating process temperature	Property
Mechanical and electrical construction	Ref. property + Block
Overall dimensions and weight	Ref. property + Block
Inline device length	Property
Structural design	Ref. property + Block
Flowtube assembly of a coriolis flowmeter	Ref. property + Block
Material of measuring tube	Property
Flowmeter body	Ref. property + Block
Number of end connections	Cardinality property
End connection 1	Ref. property + Block (R)
End connection type	Property
Nominal pressure	Property
Nominal diameter	Property
Face style	Property
Face finish	Property
Design code	Property
Material of construction	Property
Material code	Property
Reference standard for material code	Property
Secondary housing of a coriolis flowmeter	Ref. property + Block
Burst pressure of secondary housing	Property
Number of explosion protection design approvals	Cardinality property
Explosion protection design approval	Ref. property + Block (R)

Name of LOP type, block or property	***Representation of the line (object)***
Class	Property
Division	Property
Group	Property
Zone	Property
Equipment protection level	Property
Number of device groups and categories	Cardinality property
Device groups and categories	Ref. property + Block (R)
Equipment group/Device group	Property
Device category	Property
Explosive atmosphere type	Property
Type of protection	Property
Temperature class	Property
Temperature coding	Property
Regional identification	Property
Operability	Ref. property + Block
Human Machine Interface	Ref. property + Block
Display/indicator type	Property
HMI functions	Property
Power supply	Ref. property + Block
Electrical power supply input circuit	Ref. property + Block
Number of wires	Property
Voltage	Property
Voltage type	Property
Certificates and approvals	Ref. property + Block
Hazardous area approval	Ref. property + Block
Type of hazardous area approval	Property
Explosion protection approval	Property
Ex marking	Property
Device documents and remarks	Ref. property + Block
Remark	Property

Annex C
(informative)

Use cases for engineering

C.1 Use of Lists of Properties in the engineering workflow

The use of LOPs in the engineering workflow is based on the workflow for process control projects. The stages preliminary engineering, inquiry generation, offer generation, selection and detail engineering will be discussed here by way of an example. Figure C.1 indicates which types of LOPs are used at each stage. These are shown in bold type with a grey background.

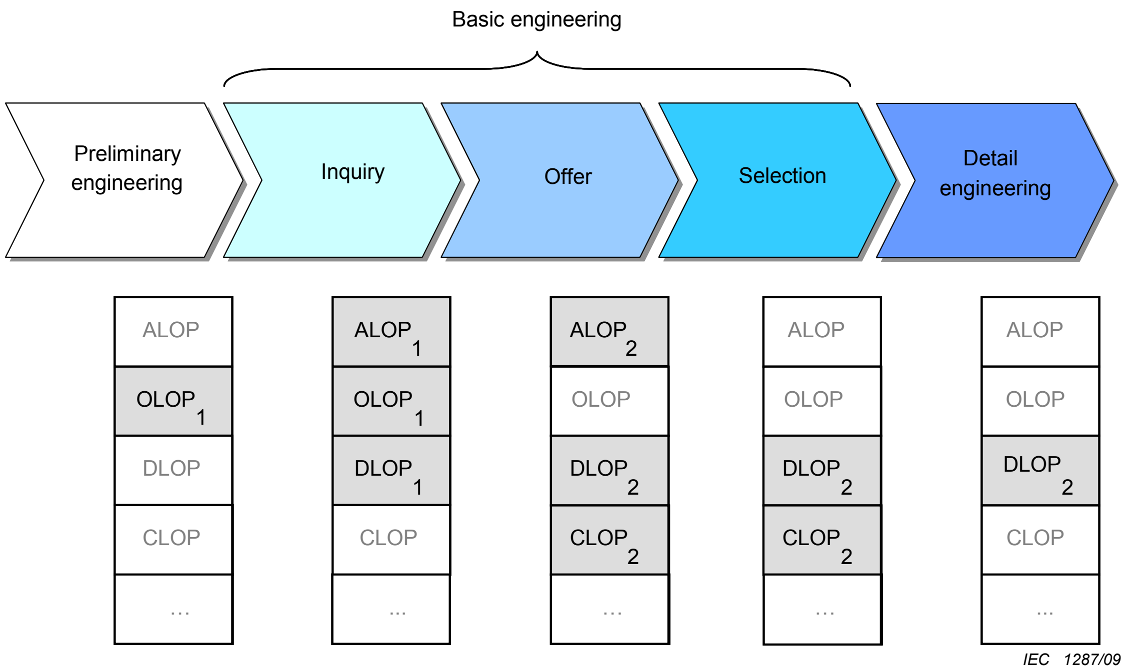

Figure C.1 – Use of LOP types at individual project stages

The application of Lists of Properties is explained using the workflow in Figure C.2. The workflow is to be largely automated. When preparing an order or a technical inquiry, the customer proceeds as follows.

- He must have access to a tool that is capable of handling the lists of properties, for example, a CAE tool.
- He selects the appropriate device type (list of properties) for his specific application case.
- He enters the inquiry data into the input masks provided by the tool. These will generally be the ALOP, the OLOP and the DLOP.
- The tool generates a transmission file (transaction data), which he sends via the Internet to one or more suppliers.

For the generation of a transmission file, every appropriate method can be used. In order to use the potential of this standard and future parts of IEC 61987 to the full, however, a computer sensible method is to be preferred.

Some CAE systems consist of several modules: a module for process engineering, including P&I diagrams, one for the piping systems and one for the process control equipment. When a new loop sheet is created, the process control module can import the required data from the processing engineering module. By use of standardized concepts (LOP, Block, properties), the process control equipment planner may be relieved of many manual input tasks, and at the same time enhances the quality of the data.

This transmitted information is used by the supplier to generate an offer. He adds more data to or changes the contents of the DLOP. In addition, he adds his own ALOP and, above all, a CLOP containing the commercial details. He then sends this offer to the customer in a previously agreed format.

Experience has shown that while exchanging data between any two parties, it is very important that the data of the person who has generated a message should be placed in the ALOP, if the workflow is to be executed properly.

The customer can now compare offers received from different suppliers and select the most appropriate one for his application. Because each property has been assigned a unique ID code, the values for the properties contained in the offers can easily be evaluated by computer. The customer can also use the data transmitted by the supplier(s) to generate his own plant or system documentation. As a result, he not only has a record of the requirements on the device, but also obtains detailed documentation of the device actually selected, which he can use for reordering or cite as a reference when clarifying any specific questions relating to that device.

To ensure the repeatability of the described workflow, both the suppliers and the customer must have an appropriate technical infrastructure.

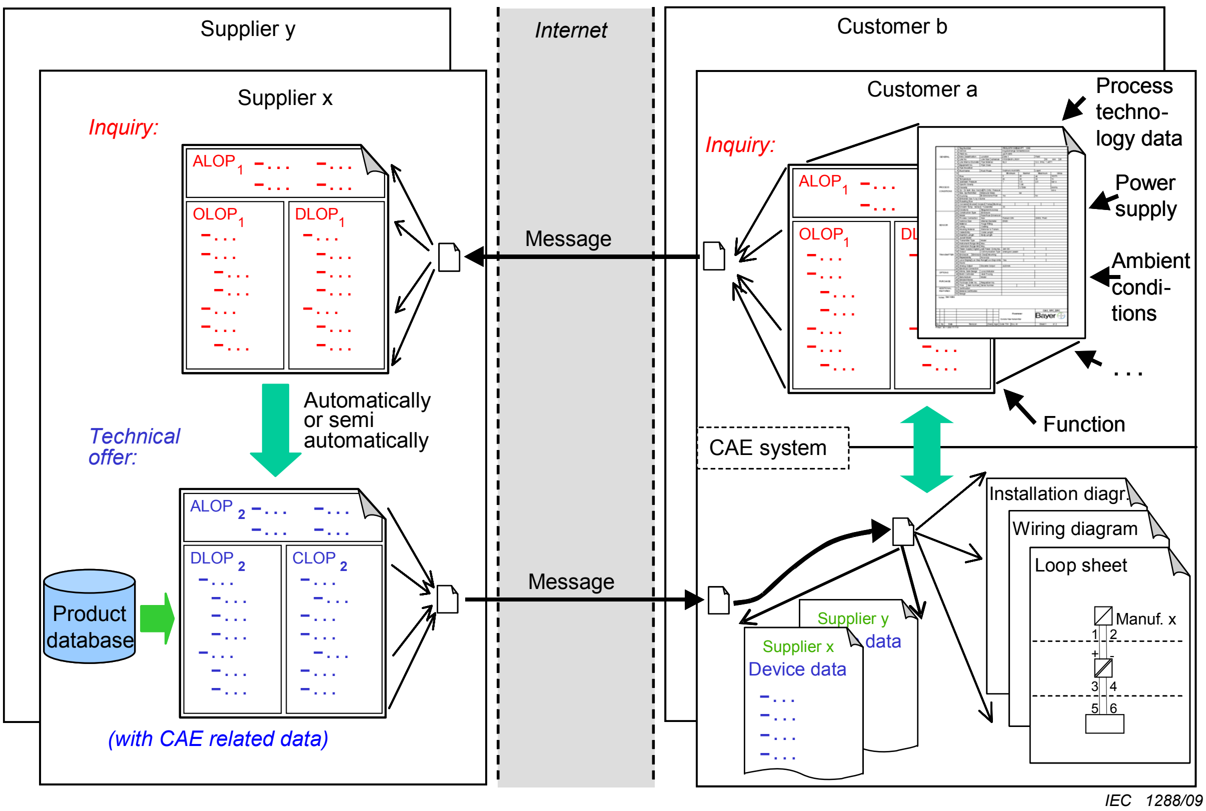

Figure C.2 – Data exchange in the engineering workflow

The following principle may be implemented in the workflow being considered (Figure C.2). All data that have to be entered in an IT system for a specific process control device or system should only need to be entered one single time throughout the entire chain of sub-processes in the workflow. Adherence to this principle considerably enhances the quality of data handling.

Figure C.2 also shows how the messages, comprising the required LOP types, are handled in the engineering workflow described. The inquiry message consists of $ALOP_1$, $OLOP_1$ and $DLOP_1$. All three should be included in a common file. $ALOP_1$ contains the information that this is an inquiry as well as the data of the author of the message; in this case the data of at least one contact person for the supplier. $OLOP_1$ contains the description of the operating and ambient conditions for which the inquired device should be designated. The owner of the data of $OLOP_1$ is the customer and he is responsible for them. Normally $DLOP_1$ will be empty, but it is also possible that the customer has specific requirements on the device.

The answer message of the supplier is sent using a different file. It consists of $ALOP_2$, $DLOP_2$ and $CLOP_2$. $ALOP_2$ contains the information that this is an offer and the data of the author of the message; in this case the data of at least one contact person for the customer. The role of $DLOP_2$ in this message is to deliver a description of a device that is the object of the offer. The supplier is the owner of the data of $DLOP_2$ and he is responsible for them. The $CLOP_2$ contains commercial information concerning the device offered and its owner is also the supplier. The customer may not change the content of $DLOP_2$ and $CLOP_2$ if he wants to use these LOPs for the generation of an order.

The two LOPs: $DLOP_1$ and $DLOP_2$ in form of the transaction data have different roles and different content in the workflow although they have been generated using the same structural data. The same is true of $ALOP_1$ and $ALOP_2$. Both have the same role (they contain header data of a message) but different content. The indices 1 and 2 have the same meaning as in Figure C.1.

The main objectives of LOPs in the engineering workflow are summarized as follows:

- to describe the operational and function requirements placed upon a process control device;
- to enable a device supplier to submit an offer for a suitable process control device based on these requirements;
- to order devices through a procurement/ purchasing system;
- to document the data of a process control device in a structured manner;
- to provide device data for planning using CAE tools.

The structural data for each device type are determined by the LOP for that device type. The data for this LOP come from the OLOP or the DLOP (see also Clause 4). The structural data determine the sequence of the properties or blocks of properties and the arrangement of these structural elements, which are indexed accordingly.

For installed devices or for requirements on devices to be delivered, transaction data are exchanged between customer and supplier or between different technical departments within a company. This means that values are assigned to the properties defined in the structure and these values are then transferred to a transmission exchange file.

The use of structural data to generate transaction data is explained below using an example and illustrated by Figure C.3.

From his experience of the process, the customer specifies that the maximum ambient temperature in his plant is 40 °C. He enters this value in the OLOP. In addition, he would like to have a current analog output signal with lower range value 4 mA and upper range value 20 mA, and specifies that the device should be designed for a maximum operating temperature of 80 °C. These are the values (transaction data) he enters for the properties (structural data) “Maximum ambient temperature”, “Output type”, “Lower range-end value of current output”, “Upper range-end value of current output” and “Upper range limit of process temperature”. He enters also “Inquiry” as value of the ALOP property “Document type”.

The technical details of the inquiry have thus been specified. They are supplemented by the header data (for example, document type). The data transmitted to one or more suppliers therefore consists of the transaction data generated from the structural data contained in the ALOP, OLOP and DLOP.

The information generated is transmitted in the form of a transmission file, or similar. Ideally, such a transmission file would be generated and used automatically by the CAE systems used on either side (see Annex C.2).

A supplier to which the transmission file has been sent can read the file into his own system and prepare an offer using the data thus transferred. The supplier generates an adapted LOP containing information as appropriate for this stage of the project. This information might be personal data of the contact at the supplier, or commercial properties such as price and delivery time.

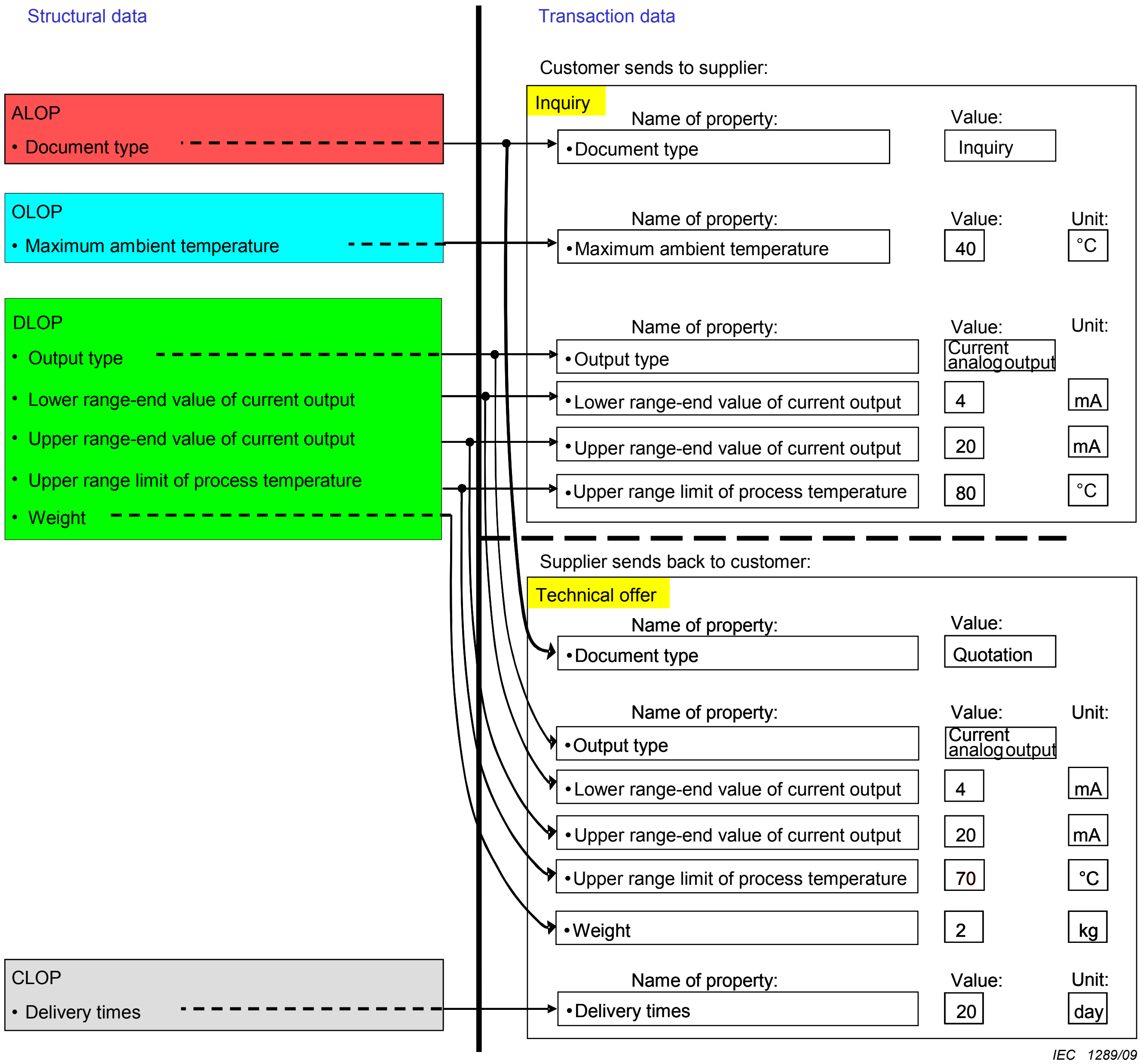

Figure C.3 – Structural and transaction data for inquiry and offer

The offer, which takes the form of an LOP consisting of ALOP, DLOP and CLOP is converted to a transmission file in the supplier's system and sent to the customer. The customer can then import either all or part of this LOP directly into his CAE system, provided the system is capable of correctly interpreting the transmission file. It should be pointed out that the inquiry of the customer and the answer of the supplier are two different transmission files. In the example, the customer receives the following information.

- The transmission file contains a quotation.
- The desired output signal type and the ranges are confirmed.
- The supplier cannot meet with the desired upper range limit of process temperature of 80 °C. He can only offer a device with a certified level of 70 °C, and he states this in the DLOP. The customer can in this case either accept the parameter or look for another supplier.
- From the additional data transmitted, the property "weight" has been selected for this example, which the supplier has stated to be 2 kg.
- The delivery times lasts 20 days.

The files used to transmit transaction data contain only the ID code of the respective property and the value which has been assigned to it by the customer or supplier. For properties which have a unit, the unit is added for the transaction. The data actually exchanged in this example by means of transmission files in LOP form are listed on the right hand side of Table C.1.

Table C.1 – Structural and transaction data for the example described

STRUCTURAL DATA					TRANSACTION DATA		
ID	Preferred name	Unit	For-mat	More attributes	ID	Value	Unit
At the inquiry							
IEC-ABA274	Document type		String	(...)	IEC-ABA274	Inquiry	
IEC-ABA291	Maximum ambient temperature	°C	Real	(...)	IEC-ABA291	40	°C
IEC-ABA169	Output type		String	(...)	IEC-ABA169	Current analog output	
IEC-ABA190	Lower range-end value of current output	mA	Real	(...)	IEC-ABA190	4	mA
IEC-ABA183	Upper range-end value of current output	mA	Real	(...)	IEC-ABA183	20	mA
IEC-ABA292	Upper range limit of process temperature	°C	Real	(...)	IEC-ABA292	80	°C
At the technical offer							
IEC-ABA274	Document type		String	(...)	IEC-ABA274	Quotation	
IEC-ABA169	Output type		String	(...)	IEC-ABA169	Current analog output	
IEC-ABA190	Lower range-end value of current output	mA	Real	(...)	IEC-ABA190	4	mA
IEC-ABA183	Upper range-end value of current output	mA	Real	(...)	IEC-ABA183	20	mA
IEC-ABA292	Upper range limit of process temperature	°C	Real	(...)	IEC-ABA292	70	°C
IEC-ABA243	Weight	kg	Real	(...)	IEC-ABA243	2	kg
IEC-ABA127	Delivery times	Day	Real	(...)	IEC-ABA127	20	Day

C.2 The role of CAE and other systems

For the practical application of this standard, CAE systems in particular play a decisive role on the customer side. They support and increase the efficiency of planning work. The CAE systems used in the planning process according to this standard must satisfy preconditions arising from the engineering workflow shown in Figure C.2.

One important condition is that all documents in the form of a transmission files, for example, should be capable of being exported from and imported to the system. It should also be possible to import CAE-relevant data such as terminal designations. The CAE systems should be capable of automatically accepting the master data of a new device type. Another important factor is the ability to compare the technical device data from several offers in the same CAE system.

The exported and imported files thus help to increase the quality of data, as considered in the context of integrated electronic data exchange with other systems, including ERP systems.

Throughout the life cycle of a device, data about the device are exchanged between the various departments concerned. On the customer side, these might be process and process control planning, operations, maintenance and procurement. On the supplier side, these might be sales, marketing, development and after sales services. The complex workflows associated with this information exchange are illustrated in Figure C.4.

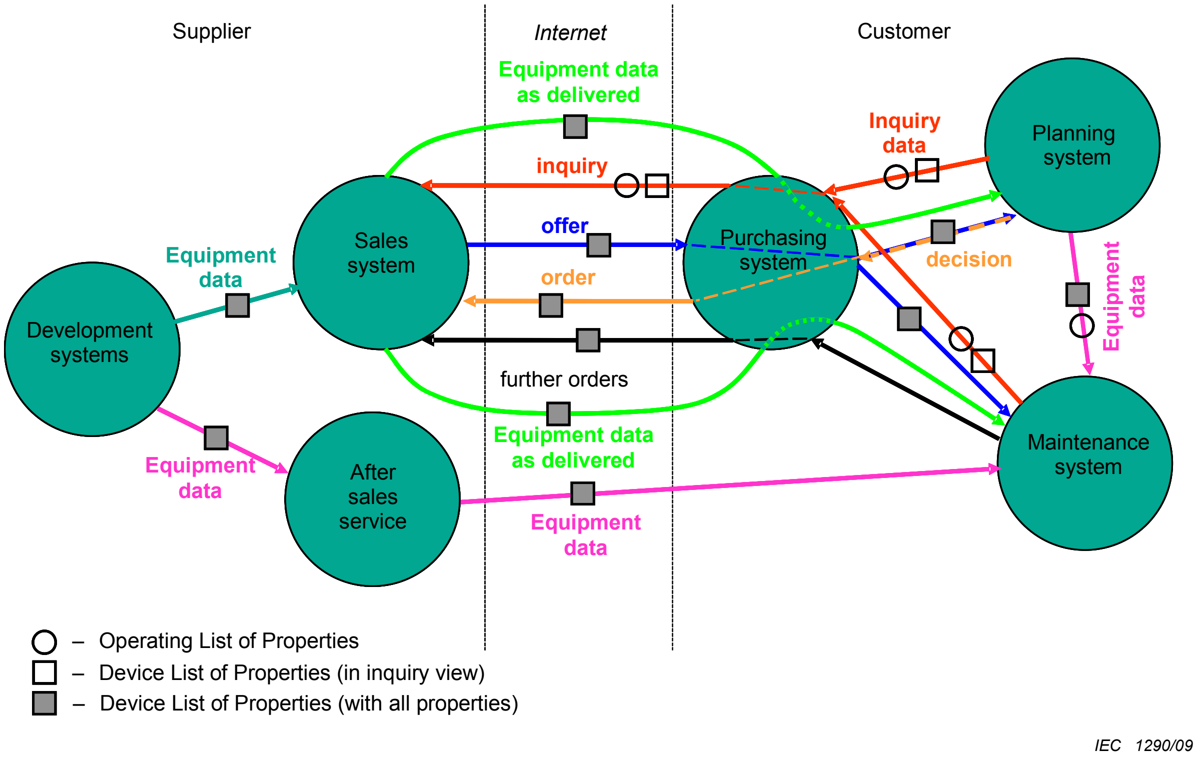

Figure C.4 – Data exchange throughout the life-cycle of a device

Parallel to the delivery of a device, the related data (as-delivered device data) can be imported into the customer's systems (for example, planning, maintenance or purchasing systems). Other important paths for transfer of device data are also shown, such as those required to take account of innovations in the development of device types (new updates of software versions).

It should be noted that data can also be stored according to other models, for example, according to ISO 15926-4. If data are to be exchanged between databases using this standard and another model, a mapping will be necessary.

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch