
**Industrial automation systems
and integration — Product data
representation and exchange —**

**Part 235:
Application protocol: Engineering
properties and materials information**

*Systèmes d'automatisation industrielle et intégration —
Représentation et échange de données de produits —*

*Partie 235: Protocole d'application: Propriétés d'ingénierie et
informations sur les matériaux*



Reference number
ISO 10303-235:2019(E)

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Published in Switzerland

Contents

Foreword.....	v
Introduction.....	vi
1 Scope	1
2 Normative references	2
3 Terms and definitions.....	3
4 Information requirements	6
4.1 Units of functionality	7
4.1.1 activity UoF	8
4.1.2 administration UoF	8
4.1.3 approval UoF	9
4.1.4 condition UoF	9
4.1.5 document_management UoF	9
4.1.6 effectivity UoF	10
4.1.7 external reference UoF	11
4.1.8 geometry UoF	11
4.1.9 geometric tolerance UoF	12
4.1.10 location UoF	12
4.1.11 measure UoF	13
4.1.12 person organisation UoF	14
4.1.13 product UoF	14
4.1.14 product_property UoF	15
4.1.15 requirement UoF	15
4.1.16 resource UoF	15
4.1.17 state UoF	16
4.1.18 substance UoF	16
4.1.19 tolerance datum UoF	16
4.2 Application objects.....	17
4.2.1 Application objects for the activity UoF	17
4.2.2 Application objects for the administration UoF	24
4.2.3 Application objects for the approval UoF	31
4.2.4 Application objects for the condition UoF	36
4.2.5 Application objects for the document_management UoF	39
4.2.6 Application objects for the effectivity UoF	46
4.2.7 Application objects for the external reference UoF	53
4.2.8 Application objects for the geometry UoF	58
4.2.9 Application objects for the geometric_tolerance UoF	68
4.2.10 Application objects for the location UoF	74
4.2.11 Application objects for the measure UoF	78
4.2.12 Application objects for the person_organisation UoF	86
4.2.13 Application objects for the product UoF	92
4.2.14 Application objects for product_property UoF	96
4.2.15 Application objects for the requirement UoF	99
4.2.16 Application objects for the resource UoF	105
4.2.17 Application objects for the state UoF	108
4.2.18 Application objects for the substance UoF	112
4.2.19 Application objects for the tolerance datum UoF	115
5 Application interpreted model	120

5.1	Mapping specification.....	120
5.1.1	Activity UoF	122
5.1.2	Administration UoF	129
5.1.3	Approval UoF	135
5.1.4	Condition UoF	140
5.1.5	Document management UoF	142
5.1.6	Effectivity UoF.....	147
5.1.7	External reference UoF.....	152
5.1.8	Geometry UoF	161
5.1.9	Geometric tolerance UoF	169
5.1.10	Location UoF	175
5.1.11	Measure UoF.....	179
5.1.12	Person organisation UoF	186
5.1.13	Product UoF.....	191
5.1.14	Product property UoF	197
5.1.15	Requirements UoF	200
5.1.16	Resource UoF	207
5.1.17	State UoF.....	209
5.1.18	Substance UoF	212
5.1.19	Tolerance datum UoF.....	216
5.2	AIM EXPRESS short listing.....	223
5.2.1	Engineering properties and materials information type definitions.....	236
5.2.2	Engineering properties and materials information entity definitions.....	247
5.2.3	Engineering properties and materials information function definitions.....	266
5.2.4	Engineering properties and materials information rule definitions.....	267
6	Conformance requirements	270
Annex A (normative)	AIM EXPRESS expanded listing.....	271
Annex B (normative)	AIM short names	542
Annex C (normative)	Implementation method specific requirements.....	561
Annex D (normative)	Protocol Implementation Conformance Statement (PICS) proforma	562
Annex E (normative)	Information object registration.....	563
Annex F (informative)	Application activity model.....	564
Annex G (informative)	Application reference model.....	585
Annex H (informative)	AIM EXPRESS-G.....	605
Annex I (informative)	Computer interpretable listings.....	691
Annex J (informative)	Detailed changes	692
Bibliography.....		696
Index	697	

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 10303-235:2009), which has been technically revised. It also incorporates the Technical Corrigendum ISO 10303-235:2009/Cor 1:2011.

The changes made in this edition are documented in Annex J.

ISO 10303 is organized as a series parts, each published separately. Each part of ISO 10303 is a member of one of the following series: descriptive methods, implementation methods, conformance testing methodology and framework, integrated generic resources, integrated application resources, application protocols, abstract test suites, application interpreted constructs and application modules. This document is a member of the application protocols series.

A list of the parts of ISO 10303 is located at: https://standards.iso.org/iso/10303/tech/step_titles.htm.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product and independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This document defines the context, scope and information requirements for properties of products that can be used for product design and design validation and other purposes, the testing, measurement and approval processes used to determine those properties and specifies the integrated resources necessary to satisfy these requirements.

Clause 1 defines the scope and summarises the functionality and data covered by this document. Clause 3 lists the words defined in this document and gives pointers to words defined elsewhere. An application activity model that is the basis for the definition of the scope is provided in Annex F. The information requirements for the application are specified in Clause 4, using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model (ARM), is given in Annex G.

Resource constructs from the Integrated Generic Resource Model are interpreted to meet the information requirements of this application and produce the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM can include items in select lists and subtypes that are not imported into the AIM. The expanded listing given in Annex A contains the complete EXPRESS schema for the AIM without annotation. A graphical representation of the AIM is given in Annex H. Additional requirements for specific implementation methods are given in Annex C.

Engineering properties, which include materials properties, are not fundamental constants derived from physical or chemical laws. The understanding of an engineering property of a product is dependent on the process used to measure the property value and the value is dependent on the conditions used in that process.

If properties that are based on fundamental physical or chemical behaviour, such as latent heat or melting temperature, are measured by different methods, then the results obtained are usually sufficiently similar to be regarded as a single value. A method used for measuring an engineering property attempts to simulate the behaviour of a product in an engineering situation in the real world. Each aspect of behaviour, for example the hardness of a product, can be simulated by several different methods. The methods are usually designed to be convenient to use and to provide a consistent result from repeated measurements. However, the difference between physical or chemical properties of a substance and the engineering properties of a product is that if different methods are used to measure an engineering property, then different results are obtained. For example, the measurement of the elongation property attempts to provide a numerical value to represent the engineering concept of plastic ductility by stretching a specially shaped sample of a product by applying a uniaxial tensile load. The value of the elongation property is determined as a percentage of the original length of a portion of a sample piece of the product. Comparisons between values of the elongation property for different products are therefore only possible if the fixed length was the same for each case. It is therefore necessary to state this length explicitly for all values of the elongation property.

An engineering property is therefore the result from operating a specific test method in a specific manner and it is necessary to associate the value of an engineering property with the conditions in which it is valid, in order for the meaning of the value to be explicitly determined. This additional

information is called the data environment in ISO 10303-45. An alternative term that is often used is metadata - i.e. data about data.

In most communications of engineering data, the relationship of a property value to its data environment or metadata is often an implicit assumption and it might not be explicitly associated with the value. The purpose of this document is to provide the means to associate a property value explicitly to the conditions in which it was measured, and thus provide an audit trail to the origins of data values that can be used in product design.

In order to measure the properties of a product, it is sometimes possible to test the whole product but usually this is not possible and a sample of a product has to be taken to represent the bulk of the product. The procedure for taking this sample can be specified in a regulatory document, such as a quality manual, or in a standard. The operation of the testing apparatus and the measurement procedure can require that the item that is tested has a specific shape and dimensions, and it will be necessary to create this from the product sample by some manufacturing process. The result of this process can be called a test piece. The specific shape and dimensions of test pieces can also be defined in standards or other regulatory documents. The measurement of the engineering property is then carried out on the test piece by means of some measuring apparatus or testing machine, whose operation might need to be controlled to be within specified limits. Manufactured products can be assemblies or single products, but they are rarely homogeneous or isotropic in their properties, so it is necessary to know the relationships between the test piece, the sample and the original product if the results of the measurement need to be related to the original product.

Data produced by a testing or measurement process is rarely used in its original form. It is necessary to first evaluate data values by some process in order to determine if the conditions prescribed for a particular test method have been met. For many properties, such as fracture toughness as an example, the validity of a test result can only be determined by an evaluation process after all the measurements have been completed and that process is specified in the standard that describes how to make the measurement. Individual results are rarely used as single values, but can be combined or processed in some way to provide a collective result that is indicative of the results of a series of measurements. It is necessary to identify the most likely value of the collection and to provide the uncertainty associated with this value.

The validity of a test result can be established by an approval procedure which results in the issue of a certificate. The certificate affirms that the original product from which the sample was taken conforms to a particular requirement or specification, and that the tests used to determine this were carried out in an approved manner. The data obtained from a valid test can also be subject to a further approval procedure that confirms the suitability of property values for the design of a functional product. This procedure will use criteria for the approval based on the requirements that the product needs to satisfy. The approval process and the criteria can be established and administered by an independent regulatory body or authority.

Test data values are not used for design because they often represent a condition of failure of the test piece. Design values are derived from the test data to represent a condition in which it is safe to use the product, and it is also advisable to record explicitly the procedures by which a design value is derived. Further testing can be required to measure the design values.

The number of different engineering properties and test methods is too large for every property and test method to be included in this document. There are also differences in test methods, and therefore differences in the engineering meaning of the properties, between different national engineering systems. Provision has therefore been made for the names of test methods and their association with particular properties to be defined in computer-processable dictionaries conforming to ISO 13584 Parts Libraries, or defined in a referenced document. An entry in such a dictionary can be referenced from the information model in this document in order to make use of a particular property name associated with a particular measurement method.

The benefit of this approach is that, with appropriate dictionaries to define test methods and their relevant property names, this document can be used for the representation of any engineering property measured by any method, provided that those methods and properties are defined in a computer processable dictionary. The application of this document therefore extends to other engineering domains and is not restricted to materials. Other applications could include the results of measurements of environmental data, for example.

Figure 1 shows a high level view of the concept of this document. Figure 2 shows the high-level view of a process. Further information on the application of product data technology to materials information, as examples of engineering properties can be found in Reference [1] in the Bibliography.

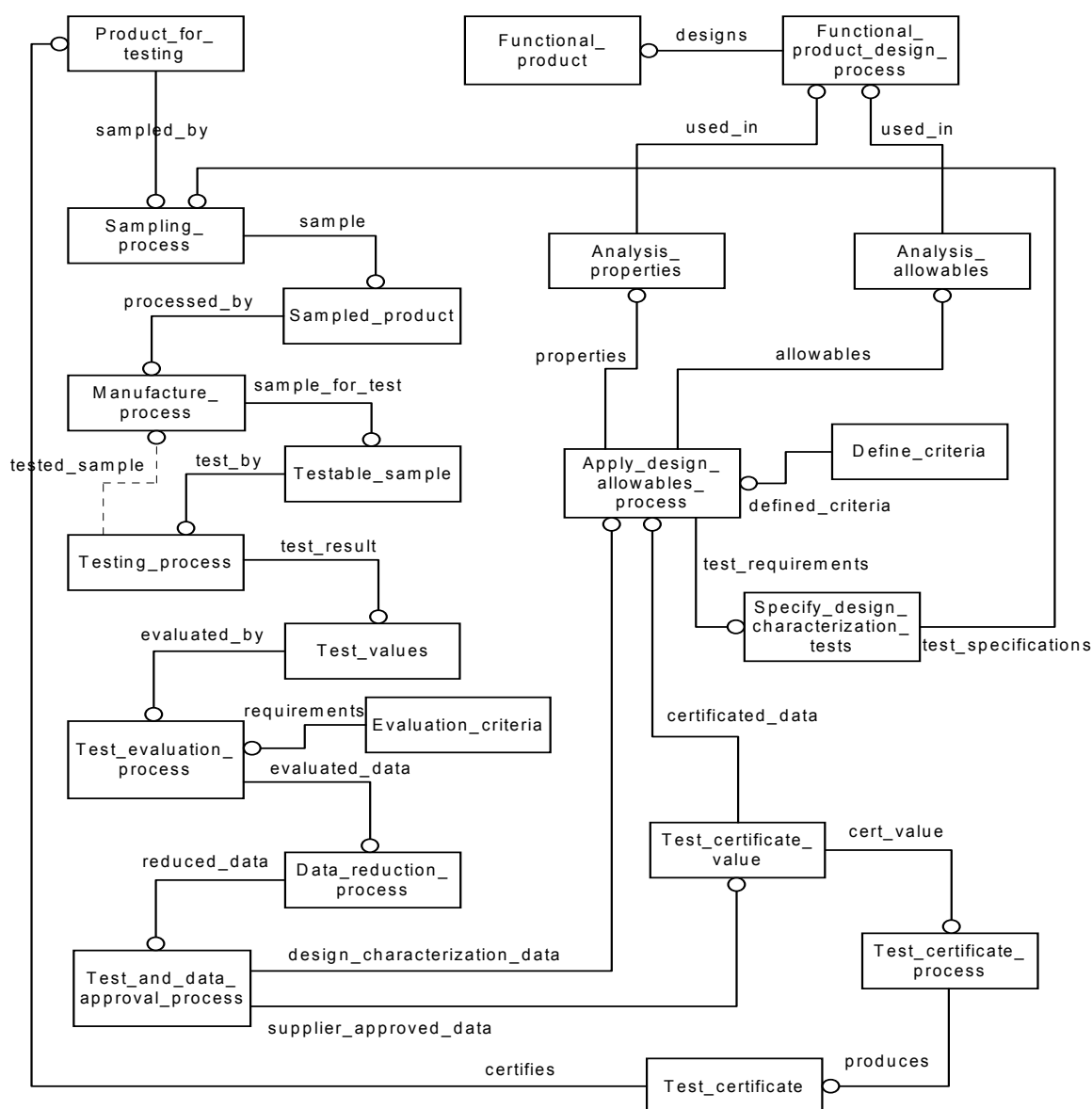


Figure 1 — Processes for the measurement and approval of engineering properties

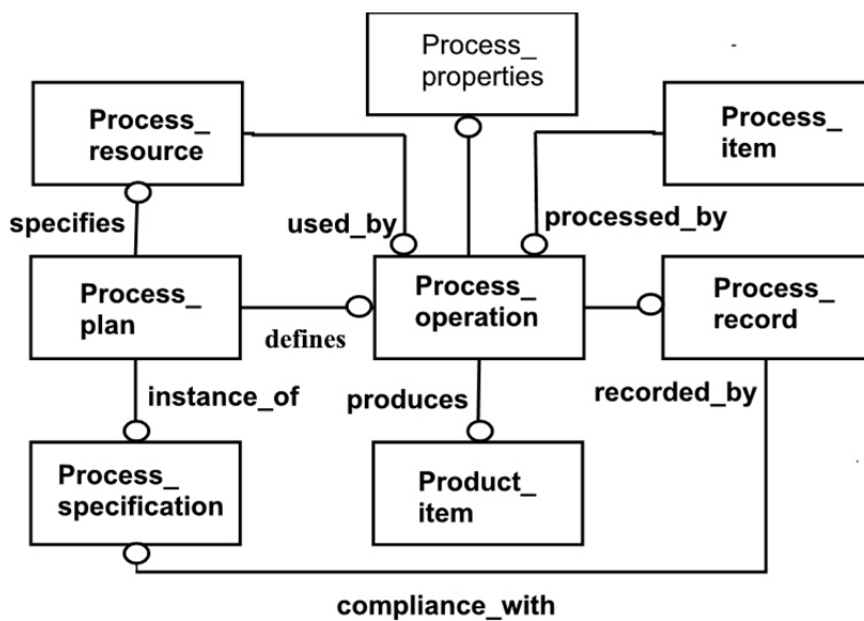


Figure 2 — Generic model for a process

Industrial automation systems and integration — Product data representation and exchange

Part 235:

Application protocol: Engineering properties and materials information

1 Scope

This document specifies the use of the integrated resources necessary for the scope and information requirements for the representation of engineering property data that are used for product design, product validation and other purposes.

NOTE 1 The application activity model in Annex F provides a graphical representation of the processes and information flows that are the basis for the definition of the scope of this document.

The following are within the scope of this document:

- descriptions and definitions of the manufactured product, the sample of the product and the testable version of the sample;
- description of the composition and substance of the product;
- description of the processes used in the measurement;
- descriptions of the data values produced by the measurement, with the specification of the conditions in which the data is valid;
- references to standards and other documents wherein sampling, measurement and other details of testing and measurement processes can be specified or described;
- descriptions and qualifications of the personnel and or organizations responsible for the measurement;
- specification of the requirements, conditions and tolerances to be satisfied in the measurement and a description of the outcome;
- descriptions of the locations of the measurement process and the effectivity of the results;
- descriptions of the approval that establishes the validity of the measurements and the use of the properties for product design, design validation and other product characteristics such as structural integrity.

NOTE 2 Data representations sometimes need to be archived to meet legal and regulatory requirements and to meet quality objectives.

The following are outside the scope of this document:

- data describing rules, guidelines and expert knowledge in the testing of products;
- names of properties and test methods;
- data describing why a decision was made to use a particular process;
- scheduling data for measurement processes;
- algorithms used for data evaluation and data processing.

NOTE 3 The names and definitions of properties and test methods are assumed to be provided in computer processable dictionaries, conforming to ISO 13584 Parts Libraries, which could classify measurement methods and their associated property types.

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.

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1) — Part 1: Specification of basic notation*

ISO 10303-1, *Industrial automation systems and integration — Product data representation and exchange — Part 1: Overview and fundamental principles*

ISO 10303-11, *Industrial automation systems and integration — Product data representation and exchange — Part 11: Description methods: The EXPRESS language reference manual*

ISO 10303-21, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*

ISO 10303-31, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts*

ISO 10303-41, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resource: Fundamentals of product description and support*

ISO 10303-42, *Industrial automation systems and integration — Product data representation and exchange — Part 42: Integrated generic resource: Geometric and topological representation*

ISO 10303-43, *Industrial automation systems and integration — Product data representation and exchange — Part 43: Integrated generic resource: Representation structures*

ISO 10303-45, *Industrial automation systems and integration — Product data representation and exchange — Part 45: Integrated generic resource: Material and other engineering properties*

ISO 10303-47, *Industrial automation systems and integration — Product data representation and exchange — Part 47: Integrated generic resource: Shape variation tolerances*

ISO 10303-49, *Industrial automation systems and integration — Product data representation and exchange — Part 49: Integrated generic resources: Process structure and properties*

ISO 10303-50, *Industrial automation systems and integration — Product data representation and exchange — Part 50: Integrated generic resource: Mathematical constructs*

ISO 10303-56, *Industrial automation systems and integration — Product data representation and exchange — Part 56: Integrated generic resource: State*

ISO 10303-519, *Industrial automation systems and integration — Product data representation and exchange — Part 519: Application interpreted construct: Geometric tolerances*

ISO 13584-20, *Industrial automation systems and integration — Parts library — Part 20: Logical resource: Logical model of expressions*

ISO 13584-26, *Industrial automation systems and integration — Parts library — Part 26: Logical resource: Information supplier identification*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 10303-1 and the following apply.

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

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

3.1

application

group of one or more processes using product data

3.2

application model

model that describes an application in terms of its processes and information flows

3.3

application construct

collection of EXPRESS language entities, types, functions, rules and references that are based on resource constructs and that specialize those resource constructs as necessary in order to define a valid description of an aspect of product data for specific application areas

3.4

application context

subset of an application activity model

3.5

application interpreted construct

AIC

logical grouping of interpreted constructs that supports a specific function for the usage of product data across multiple application contexts

3.6
application interpreted model

AIM

information model that includes the application constructs necessary to satisfy the requirements of an application reference model

3.7
application object

atomic element of an application reference model that defines a unique concept of the application and contains attributes specifying the data elements of the object

3.8
application protocol

AP

part of ISO 10303 that specifies an application interpreted model satisfying the scope and information requirements for a specific application

3.9
application reference model

ARM

information model that describes the information requirements and constraints of an application within an application protocol

3.10
unit of functionality

UoF

collection of application objects and their relationships that defines one or more concepts within the application context such that removal of any component would render the concepts incomplete or ambiguous

3.11
conformance class

subset of an application protocol for which compliance can be claimed

3.12
conformance requirement

precise, text definition of a characteristic required to be present in an implementation for achieving compliance

3.13
data

representation of information in a formal manner suitable for communication, interpretation, or processing by human beings or computers

3.14
data exchange

storing, accessing, transferring and archiving of data

3.15
exchange structure

computer-interpretable format used for storing, accessing, transferring and archiving data

3.16**implementation method**

part of ISO 10303 that specifies a technique used by computer systems to exchange product data that is described using the EXPRESS data specification language

3.17**information**

facts, concepts, or instructions

3.18**information model**

formal model of a bounded set of facts, concepts or instructions to meet a specific requirement

3.19**resource construct**

collection of EXPRESS language entities, types, functions, rules and references that together define a valid description of product data

3.20**integrated resource****IR**

part of ISO 10303 that defines a group of resource constructs used as the basis for product data

3.21**generic resource**

integrated resource whose contexts are context-independent

3.22**interpretation**

process of adapting a resource construct to satisfy an application-specific requirement of an application protocol

Note 1 entry: This can involve the additions of restrictions on attribute, the addition of constraints and the addition of assignments.

3.23**product**

thing or substance produced by a natural or artificial process

3.24**product data**

representation of information about a product in a formal manner suitable for communication, interpretation, or processing by human beings or by computers

3.25**product information**

facts, concepts, or instructions about a product

3.26**product information model**

information model that provides an abstract description of facts, concepts and instructions about a product

3.27

presentation

recognizable visual representation of product data

3.28

structure

set of interrelated parts of any complex thing, and the relationships between them

3.29

data environment

set of application objects that allows the conditions related to the validity of one or more property values to be grouped together

3.30

material product

physical object that is manufactured to a specification and from which other objects can be manufactured

3.31

sample

portion of a material product that is selected by a specified procedure to ensure that the portion is representative of the whole material product

3.32

test method

test

procedure designed to measure the characteristics of a material product in specified conditions

3.33

test specimen

physical object that is manufactured from a sample in order to be used in a test

Note 1 to entry: The manufacture, shape and dimensions of a test specimen can be specified for the test method.

3.34

tested specimen

test specimen after it has been used in a test

Note 1 to entry: A tested specimen can be used in further tests.

4 Information requirements

This clause specifies the information required for the representation and exchange of engineering properties and the processes and conditions in which the values were measured.

The information requirements are specified as a set of units of functionality (UoF) and application objects. A unit of functionality specifies the collection of application objects that are needed to satisfy a general information requirement. The information requirements are defined using the terminology of the subject area of this document. The information objects in this clause, and all subsequent clauses that include computer-processable code, shall be presented in the EXPRESS language that is defined in ISO 10303-11.

NOTE 1 A graphical representation of the information requirements is given in Annex G.

NOTE 2 The information requirements correspond to those of the activities identified in Annex F as being within the scope of this document.

NOTE 3 The mapping specification specified in 5.1 shows how the integrated resources and application interpreted constructs are used to meet the information requirements.

4.1 Units of functionality

This subclause specifies the units of functionality for Engineering properties and materials information. The following units of functionality are specified:

- activity;
- administration;
- approval;
- condition;
- document management;
- effectivity;
- external reference;
- geometry;
- geometric tolerance;
- location;
- measure;
- person organisation;
- product;
- properties;
- requirement;
- resource;
- state;
- substance;
- tolerance datum.

The units of functionality and a description that each UoF supports are given below. The application objects included in the UoFs are defined in 4.2.

4.1.1 activity UoF

The activity UoF enables the description of the operations and the properties for a process. The activity UoF uses the following application objects:

- Activity_as_planned;
- Activity_as_realised;
- Activity_property;
- Activity_property_defined_in_external_reference;
- Activity_property_relationship;
- Activity_property_representation;
- Activity_relationship;
- Activity_type;
- Activity_type_defined_in_external_reference;
- Activity_type_relationship;
- Activity_type_specified;
- Individual_activity;
- Individual_activity_assignment.

4.1.2 administration UoF

The administration UoF enables the description of the administration of the testing and measurement processes. The administration UoF uses the following application objects:

- Calendar_date;
- Contract;
- Contract_assignment;
- Date_time;
- Event;
- Event_relationship;
- Local_time;
- Project;
- Specification;

- Specification_relationship;
- Specification_type;
- Time_offset.

4.1.3 approval UoF

The approval UoF enables the description of the approval and certification of the data used and generated in the testing and measurement processes. The approval UoF uses the following application objects:

- AP_qualification_type;
- Approval;
- Approval_assignment;
- Approval_relationship;
- Approval_status;
- Approving_person_organisation;
- Certificate;
- Certificate_assignment;
- Security_classification.

4.1.4 condition UoF

The condition UoF enables the description of the conditions that shall be satisfied in a testing and measurement process. The condition UoF uses the following application objects:

- Condition;
- Condition_assignment;
- Condition_evaluation;
- Condition_evaluation_assignment;
- Condition_relationship.

4.1.5 document_management UoF

The document_management UoF enables the description of documents used to support the testing and measurement process and store the results. The document_management UoF uses the following application objects:

- Digital_document_definition;
- Digital_file;

- Digital_record;
- Document;
- Document_assignment;
- Document_definition;
- Document_definition_relationship;
- Document_location_identification;
- Document_relationship;
- Document_version;
- External_item_identification;
- External_source_identification;
- File;
- File_location_identification;
- File_relationship;
- Hard_copy;
- Physical_document_definition.

4.1.6 effectivity UoF

The effectivity UoF enables the conditions to be described in which data is effective. The effectivity UoF uses the following application objects:

- Dated_effectivity;
- Effectivity;
- Effectivity_assignment;
- Effectivity_relationship;
- Frequency_interval;
- Lot_effectivity;
- Serial_effectivity;
- Time_interval;
- Time_interval_effectivity;
- Time_interval_relationship;

— Time_interval_with_bounds.

4.1.7 external reference UoF

The external reference UoF enables references to external sources of information to be described. The external_reference UoF uses the following application objects:

- Alias_identification;
- External_library_reference;
- Language;
- Multi_language_string;
- PLIB_class_reference;
- PLIB_property_reference;
- String_with_language.

4.1.8 geometry UoF

The geometry UoF enables the shape and orientation of physical objects in the testing and measurement processes to be described. The geometry UoF uses the following application objects:

- Axis_placement;
- Axis_placement_mapping;
- Axis_placement_transformation_mapping;
- Cartesian_point;
- Cartesian_transformation_2D;
- Cartesian_transformation_3D;
- Dependent_shape_dimension_representation;
- Direction;
- Geometric_coordinate_space;
- Geometric_model;
- Geometric_model_element;
- Shape;
- Shape_defined_in_external_reference;
- Shape_dimension;

- Shape_dimension_representation;
- Shape_element;
- Shape_element_dimension;
- Shape_element_dimension_representation.

4.1.9 geometric tolerance UoF

The geometric tolerance UoF enables the specification of the permitted deviation from a nominal or ideal geometrical shape to be described. The geometric tolerance UoF uses the following application objects:

- Angularity_tolerance;
- Coaxiality_tolerance;
- Concentricity_tolerance;
- Cylindricity_tolerance;
- Flatness_tolerance;
- Geometric_tolerance;
- Geometric_tolerance_relationship;
- Parallelism_tolerance;
- Perpendicularity_tolerance;
- Position_tolerance;
- Reference_datum;
- Roundness_tolerance;
- Straightness_tolerance;
- Symmetry_tolerance;
- Tolerance_zone;
- Tolerance_zone_definition;
- Total_runout_tolerance.

4.1.10 location UoF

The location UoF enables the place where an event occurred to be described. The location UoF uses the following application objects:

- Address_location_representation;

- Global_location_representation;
- Location;
- Location_representation;
- Location_representation_relationship;
- Organisation_location_representation;
- Organisational_location_identification;
- Product_location_representation;
- Regional_grid_location_representation.

4.1.11 measure UoF

The measure UoF enables the values of quantities to be described. The measure UoF uses the following application objects:

- Context_dependent_unit;
- Count_measure;
- Derived_unit;
- Derived_unit_element;
- Descriptive_measure;
- Duration;
- Maths_expression_value;
- Measure_item;
- Numerical_measure_value;
- Qualified_expression;
- Qualified_measure;
- Qualifier_precision;
- Qualifier_type;
- Qualifier_uncertainty;
- Range_measure;
- Ratio_measure;
- Uncertainty_expanded;

- Uncertainty_qualitative;
- Uncertainty_standard;
- Unit;
- Unit_relationship.

4.1.12 person organisation UoF

The person organisation UoF enables the description of persons and organisations. The person organisation UoF uses the following application objects:

- Address;
- Facsimile_address;
- Network_address;
- Organisation;
- Organisation_relationship;
- Organisation_type;
- Person;
- Person_in_organisation;
- Postal_address;
- Qualification;
- Qualification_relationship;
- Telephone_address.

4.1.13 product UoF

The product UoF enables the description of the products to which the results of the testing and measurement processes apply. The product UoF uses the following application objects:

- Individual_product;
- Individual_product_feature;
- Product_as_planned;
- Product_as_realised;
- Product_feature_relationship;
- Product_type;
- Product_type_defined_in_external_reference;

- Product_type_relationship;
- Product_type_specified;

4.1.14 product_property UoF

The product_property UoF enables a property of a product to be described. The product_property UoF uses the following application objects:

- Engineering_property;
- Engineering_property_defined_in_external_reference;
- Engineering_property_representation;
- Property_environment_relationship;
- Property_environment_representation;
- Property_representation_relationship;

4.1.15 requirement UoF

The requirement UoF enables the description of items that are needed in a testing and measurement process. The requirement UoF uses the following application objects:

- Required_resource;
- Required_resource_by_resource_item;
- Required_resource_by_specification;
- Required_resource_relationship;
- Requirement;
- Requirement_assignment;
- Requirement_source;
- Requirement_version;
- Requirement_version_relationship;
- Requirement_view_definition.

4.1.16 resource UoF

The resource UoF describe the items and their properties that are used for the measurement of an engineering property. The resource UoF uses the following application objects:

- Resource_item;
- Resource_item_assignment;

- Resource_item_characterisation;
- Resource_item_relationship.
- Resource_property;
- Resource_property_defined_in_external_reference;
- Resource_property_representation.

4.1.17 state UoF

The state UoF enables the specification of the condition of something at a particular time. The state UoF uses the following application objects:

- Derived_state_type;
- Process_defined_state_type;
- Product_type_defined_state_type;
- Property_defined_state_type;
- Quantity;
- State_Type;
- State_type_assignment;
- State_type_relationship.

4.1.18 substance UoF

The substance UoF enables the description of the physical and chemical state of a substance. The substance UoF uses the following application objects:

- Structure_element_characterisation;
- Substance;
- Substance_assignment;
- Substance_composition_element;
- Substance_defined_in_external_reference;
- Substance_structure_element.

4.1.19 tolerance datum UoF

The tolerance datum UoF enables the description of the datum from which the permitted deviation from a nominal or ideal geometrical shape can be specified. The tolerance datum UoF uses the following application objects:

- Compound_datum;

- Datum;
- Datum_target;
- Datum_target_set;
- Placed_target;
- Reference_shape;
- Reference_shape_element;
- Single_datum;
- Target_area;
- Target_circle;
- Target_point;
- Target_rectangle;
- Target_straight_line;
- Tolerance_condition.

4.2 Application objects

This subclause specifies the application objects for the Engineering properties and materials information application protocol. Each application object is an atomic element that embodies a unique application concept and may contain attributes specifying the data elements of the object. The application objects, their definitions and attributes are specified below. The application objects and other data types are grouped in subclauses identified with a Unit of Functionality.

4.2.1 Application objects for the activity UoF

This subclause specifies the data types and application objects associated with the Activity UoF. For the EXPRESS-G ARM diagram for this clause, see Annex G, Figure G.1.

4.2.1.1 activity_select

An activity_select is a mechanism for proving an association between an instance of Activity_property and an instance of one of:

- Activity_type;
- Individual_activity.

EXPRESS specification:

```
*)
TYPE activity_select = SELECT
    (Activity_type,
     Individual_activity);
```

```
END_TYPE;  
(*
```

4.2.1.2 assignment_select

An assignment_select is a select data type that provides a mechanism for associating an instance of Individual_activity with an instance of one of:

- Approval;
- Certificate;
- Document_version;
- Individual_product;
- Engineering_property_representation.

EXPRESS specification:

```
*)  
TYPE assignment_select = SELECT  
    (Approval,  
        Certificate,  
        Document_version,  
        Individual_product,  
        Engineering_property_representation);  
END_TYPE;  
(*
```

4.2.1.3 Activity_as_planned

An Activity_as_planned is a type of Individual_activity that is intended to happen.

EXPRESS specification:

```
*)  
ENTITY Activity_as_planned  
SUBTYPE OF (Individual_activity);  
plan : Activity_type;  
END_ENTITY;  
(*
```

Attribute definitions:

plan: identification of the **Activity_type** that is intended to be used

4.2.1.4 Activity_as_realised

An Activity_as_realised is a type of Individual_activity that occurred.

EXPRESS specification:

```
*)  
ENTITY Activity_as_realised  
SUBTYPE OF (Individual_activity);  
realisation_of : Activity_as_planned;  
of_type : Activity_type;  
END_ENTITY;
```

(*

Attribute definitions:

realisation_of: instance of the Activity that was planned

of_type: class of activity of which the Activity_as_realised is a member

4.2.1.5 Activity_property

An Activity_property is the characteristic of the behaviour, capabilities or performance of a process.

EXPRESS specification:

```
*)
ENTITY Activity_property;
  of_activity          : activity_select;
  description          : STRING;
  name                : STRING;
END_ENTITY;
( *
```

Attribute definitions:

of_activity: reference to the activity of which the Activity_property is a characteristic

description: text that provides and explanation of the Activity_property

name: label by which the Activity_property can be recognized

4.2.1.6 Activity_property_defined_in_external_reference

An Activity_property_defined_in_external_reference is a type of Activity_property that is defined in an external source.

EXPRESS specification:

```
*)
ENTITY Activity_property_defined_in_external_reference
  SUBTYPE OF (Activity_property);
  select_source: property_source_select;
END_ENTITY;
( *
```

Attribute definitions:

select_source: reference to the identification of a property defined in an external source

4.2.1.7 Activity_property_relationship

An Activity_property_relationship is an association between two instances of Activity_property.

EXPRESS specification:

```
*)
```

```
ENTITY Activity_property_relationship;  
related      : Activity_property;  
relating     : Activity_property;  
description  : STRING;  
name         : STRING;  
END_ENTITY;  
(*
```

Attribute definitions:

relate: one of the instances of Activity_property that participates in the association

NOTE If one of the instances of Activity_property depends on the other then this is the dependent one.

relating: the other instance of Activity_property that participates in the association

description: text that provides and explanation of the association

name: label by which the association can be recognised

4.2.1.8 Activity_property_representation

An Activity_property_representation is a representation of an Activity_property.

NOTE An Activity_property can have many representations.

EXPRESS specification:

```
*)  
ENTITY Activity_property_representation;  
of_property  : Activity_property;  
name         : STRING;  
description  : STRING;  
value_item:  Measure_item;  
END_ENTITY;  
(*
```

Attribute definitions:

of_property: reference to the characteristic that is being represented

name: label by which the representation can recognised

description: text provide an explanation of the representation

value_item: the measure of the item of the representation

4.2.1.9 Activity_relationship

An Activity_relationship is an association between two instances of Individual_activity.

EXPRESS specification:

```

*)
  ENTITY Activity_relationship;
  relating_activity : Individual_activity;
  related_activity  : Individual_activity;
  description       : STRING;
  relation_type     : STRING;
  END_ENTITY;
( *

```

Attribute definitions:

relating_activity: one of the instances of Individual_activity participating in the association

related_activity: the other instance of Individual_activity participating in the association

NOTE If one element of the association is dependent on the other then this attribute is the dependent one

description: text that describes the nature of the relationship

relation_type: text that defined the meaning of the relationship

4.2.1.10 Activity_type

An Activity_type is a procedure to achieve an objective.

EXPRESS specification:

```

*)
  ENTITY Activity_type;
  name      : STRING;
  description : STRING;
  END_ENTITY;
( *

```

Attribute definitions:

name: label by which an Activity_type is known and can be referred to

description: text that characterises an Activity_type

4.2.1.11 Activity_type_defined_in_external_reference

An Activity_type_defined_in_external_reference is a type of Activity_type that is described in an external source.

EXPRESS specification:

```

*)
  ENTITY Activity_type_defined_in_external_reference
  SUBTYPE OF(Activity_type);
  class_select : classification_source_select;
  END_ENTITY;
( *

```

Attribute definitions:

class_select: identification of the external reference

4.2.1.12 Activity_type_relationship

An Activity_type_relationship is an association between two instances of Activity_type.

EXPRESS specification:

```
*)
  ENTITY Activity_type_relationship;
    relating_process          : Activity_type;
    related_process           : Activity_type;
    description               : STRING;
    relation_type             : STRING;
  END_ENTITY;
(*
```

Attribute definitions:

relating_process: one of the instances of Activity_type participating in the relationship

related_process: the other instance of Activity_type participating in the relationship

NOTE If one element of the relationship is dependent on the other then this attribute is the dependent one.

description: text that describes the nature of the relationship

relation_type: text that defines the meaning of the relationship

4.2.1.13 Activity_type_specified

An Activity_type_specified is a type of Activity_type that is defined in a formal specification.

EXPRESS specification:

```
*)
  ENTITY Activity_type_specified
    SUBTYPE OF (Activity_type);
    activity_specification      : Specification;
  END_ENTITY;
(*
```

Attribute definitions:

activity_specification: reference to a formal definition of the Activity_type

4.2.1.14 Individual_activity

An Individual_activity is the identification of an occurrence of an Activity_type.

EXPRESS specification:

```
*)
  ENTITY Individual_activity
```

```

SUPERTYPE OF (ONEOF(Activity_as_planned, Activity_as_realised));
description                : STRING;
activity_name              : STRING;
activity_id               : STRING;
activity_role              : STRING;
activity_event             : date_or_event;
responsible               : person_organisation;
END_ENTITY;
( *

```

Attribute definitions:

description: text that provides information about an Individual_activity

activity_name: label by which an Individual_activity is known and can be referred to

activity_id: label that distinguishes an Individual_activity

activity_role: description of the objective of the Individual_activity

activity_event: information to describe when and where an Individual_activity occurred

responsible: person and or organisation responsible for carrying out the Individual_activity

4.2.1.15 Individual_activity_assignment

An Individual_activity_assignment is a mechanism for associating an Individual_activity with an item.

EXPRESS specification:

```

*)
ENTITY Individual_activity_assignment;
assigned_individual_activity : Individual_activity;
assigned_role                : STRING;
assignment_item:             assignment_select;
END_ENTITY;
( *

```

Attribute definitions:

assigned_individual_activity : reference to the Individual_activity that is to be associated

assigned_role: specification of the purpose of the Individual_Activity_assignment with product or activity data

REMARK Where applicable, the following values shall be used for assigned_role:

input', where the concepts represented by the assigned_items are inputs to the Activity

'output', where the concepts represented by the assigned_items result from the Activity;

'constraint', where the concepts represented by the assigned_items influence the execution of the Activity.

assignment_item: identification of the item assigned to an Individual_activity

4.2.2 Application objects for the administration UoF

This subclause specifies the data types and application objects associated with the administration UoF. For the EXPRESS-G ARM diagram for this clause, see Annex G, Figure G.2.

4.2.2.1 offset_orientation

An offset_orientation is the position of a time zone with respect to the Coordinated Universal Time zone (UTC).

EXPRESS specification:

```
*)
  TYPE offset_orientation = ENUMERATION OF
    (AHEAD,
     EXACT,
     BEHIND);
  END_TYPE;
(*
```

4.2.2.2 contract_item

A contract_item is a select data type that defines an extensible list of alternate items to which a contract may be assigned.

NOTE The items in the list can be extended in an application that implements this document.

An instance of Contract may be associated with an instance of one of:

- Individual_activity;
- Individual_product.

EXPRESS specification:

```
*)
  TYPE contract_item = EXTENSIBLE_SELECT
    (Individual_activity,
     Individual_product);
  END_TYPE;
(*
```

4.2.2.3 date_or_date_time

A date_or_date_time is a select data type that provides a mechanism to refer to an instance of Calendar_date or an instance of Date_time.

EXPRESS specification:

```
*)
  TYPE date_or_date_time = SELECT
    (Date_time,
     Calendar_date);
  END_TYPE;
(*
```

4.2.2.4 date_or_event

A `date_or_event` is a select data type that provides a mechanism to refer to an instance of: a `Calendar_date`, a `Date_time`, or an `Event`.

EXPRESS specification:

```
*)
  TYPE date_or_event = SELECT
    (Event,
     date_or_date_time);
  END_TYPE;
(*
```

4.2.2.5 Calendar_date

A `Calendar_date` is the identification of a day in a month of a year.

EXPRESS specification:

```
*)
  ENTITY Calendar_date;
  year          : INTEGER;
  month         : INTEGER;
  day           : INTEGER;
  END_ENTITY;
(*
```

Attribute definitions:

year: identifier for the year in a `Calendar_date`

month: identifier for a month in a `Calendar_date`

day: identifier for a day in a `Calendar_date`

4.2.2.6 Contract

A `Contract` is a binding agreement between at least two participants.

EXPRESS specification:

```
*)
  ENTITY Contract;
  effective_date:      Calendar_date;
  contract_id       : STRING;
  contractee        : person_organisation;
  contractor        : SET [1:?] OF person_organisation;
  for_project       : Project;
  END_ENTITY;
(*
```

Attribute definitions:

effective_date: calendar date on which the agreement becomes effective

contract_id: label that identifies an instance of `Contract`

contractee: beneficiary of the agreement

contractor: executor of the agreement

for_project: reference to the Project for which a Contract is valid

4.2.2.7 Contract_assignment

A Contract_assignment provides a mechanism for the association of a Contract with activity or product data.

EXPRESS specification:

```
*)
ENTITY Contract_assignment;
  Items                : SET [1:?] OF contract_item;
  assigned_contract    : Contract;
END_ENTITY;
(*
```

Attribute definitions:

items: activity or product data to which an instance of Contract is assigned

assigned_contract: instance of Contract that is to be associated with activity or product data

4.2.2.8 Date_time

A Date_time is a moment of time on a particular day.

EXPRESS specification:

```
*)
ENTITY Date_time;
  date                : Calendar_date;
  time                : Local_time;
END_ENTITY;
(*
```

Attribute definitions:

date: reference to an instance of Calendar_date that specifies the particular day

time: reference to the instance of Local_time that specifies the moment of time on a particular day

4.2.2.9 Event

An Event is a fact of something occurring at a point in time.

EXPRESS specification:

```
*)
ENTITY Event;
```

```

actual_date           : date_or_date_time;
event_name            : STRING;
event_id              : STRING;
description            : STRING;
event_location        : Location;
END_ENTITY;
(*)

```

Attribute definitions:

actual_date: instance of Calendar_date or Date_time associated with an Event

event_name: label by which an instance of Event is known and can be referred to

event_id: label that distinguishes an event

description: words that further characterise an Event

event_location: particular place where the event occurred

4.2.2.10 Event_relationship

An Event_relationship is an association between two instances of Event.

EXPRESS specification:

```

*)
ENTITY Event_relationship;
relating_event        : Event;
related_event          : Event;
relation_type          : STRING;
description            : STRING;
END_ENTITY;
(*)

```

Attribute definitions:

relating_event: one of the instances of Event that is part of the association

related_event: the other instance of Event that is part of the association

NOTE If one element of the relationship is dependent on the other then this attribute is the dependent one

relation_type: definition of the association between the event

NOTE 1 Where applicable the following values can be used:

- 'actualisation': the relationship specifies that the relating Event identifies a predicted or planned event and the related Event identifies the point in time when that event actually occurred. This relationship is valid if the actual_date attribute of the relating Event is not specified and the actual_date attribute of the related Event is specified, or, if both these attributes are specified and are equal;
- 'exclusiveness': the relationship specifies that the relating and the related Event do not have any overlap during their duration;

- 'sequence': the relationship specifies that the relating Event are completed before the related Event starts;
- 'simultaneity': the relationship specifies that both the relating and the related event are considered as occurring during the same time period or are performed together in order to ensure consistency and enhance efficiency.

NOTE 2 The criteria for 'simultaneity' and in particular the delay allowed between two events declared as simultaneous depend on the application.

description: information about the relationship between two instances of Event

4.2.2.11 Local_time

A Local_time is a point in time in a day represented on a 24-hour clock by hour, minute and second.

NOTE The time is expressed in the local time zone and the offset from the Coordinated Universal Time is specified.

EXPRESS specification:

```
*)
ENTITY Local_time;
hour      : INTEGER;
minute    : INTEGER;
second    : REAL;
zone      : Time_offset;
END_ENTITY;
(*
```

Attribute definitions:

hour : number of hours at the Local_time

minute : number of minutes at the Local_time

second : number of seconds at the Local_time

zone : reference to Time_offset to determine the deviation from the Coordinated Universal Time

NOTE 1 The symbol for Coordinated Universal Time is UTC.

NOTE 2 The determination of the local time is determined as follows:

- if Time_offset.sense = 'ahead' then Local_time = UTC - hour_offset - minute_offset;
- if Time_offset.sense = 'exact' then Local_time = UTC;
- if Time_offset.sense = 'behind' then Local_time = UTC + hour_offset + minute_offset.

4.2.2.12 Project

A Project is an enterprise or activity planned to achieve a particular objective.

EXPRESS specification:

```
*)
  ENTITY Project;
    project_id          : STRING;
    project_name        : STRING;
  END_ENTITY;
(*
```

Attribute definitions:

project_id: label by which the Project can be distinguished

project_name: label by which a Project is known and can be identified

4.2.2.13 Specification

A Specification is a formal definition of a state of a product or an activity.

NOTE A Specification can be a standard.

EXPRESS specification:

```
*)
  ENTITY Specification;
    of_type              : Specification_type;
    id: STRING;
    issued_by            : Organisation;
    date                 : Calendar_date;
    specification_document : Document_version;
  END_ENTITY;
(*
```

Attribute definitions:

of_type: reference to the Specification_type of which the Specification is an instance

id: label by which the Specification can be identified

issued_by: identification of the organisation responsible for the specification

date: calendar date on which the specification was issued

specification_document: document where the Specification is described

4.2.2.14 Specification_relationship

A Specification_relationship is an association between two instances of Specification.

EXPRESS specification:

```
*)
  ENTITY Specification_relationship;
```

```

related          : Specification;
relating         : Specification;
relation_type:   : STRING;
description      : STRING;
END_ENTITY;
(*)

```

Attribute definitions:

related: the other Specification that is part of the relationship.

NOTE If one element of the relationship is dependent upon the other, then this attribute is the dependent one.

relating: one of the Specifications that is part of the Specification_relationship

relation_type: text that defines the meaning of the relationship

description: text that provides further information about the relationship

4.2.2.15 Specification_type

A Specification_type is the class of Specification to which an instance of a Specification may belong.

EXPRESS specification:

```

*)
ENTITY Specification_type;
name          : STRING;
description   : STRING;
END_ENTITY;
(*)

```

Attribute definitions:

name: label by which a Specification type is known

description: information about the Specification type

4.2.2.16 Time_offset

A Time_offset is the oriented offset from Coordinated Universal Time.

EXPRESS specification:

```

*)
ENTITY Time_offset;
sense          : offset_orientation;
hour_offset    : INTEGER;
minute_offset  : INTEGER;
DERIVE
actual_minute_offset : INTEGER := actual_minute_offset : INTEGER
:= NVL(minute_offset, 0);
WHERE
WR1             : {0 <= hour_offset < 24};
WR2             : {0 <= minute_offset <= 59};
WR3             : NOT (((hour_offset <> 0) OR (actual_minute_offset

```

```

    <> 0)) AND (sense = exact));
END_ENTITY;
(*)

```

Attribute definitions:

sense: direction of the offset from Universal Coordinated Time

hour_offset: number of hours by which a time is offset from Coordinated Universal Time

minute_offset: the number of minutes by which a time is offset from Coordinated Universal Time

actual_minute_offset: value of the minute offset used to compute a Time_offset.

NOTE The value is zero if the value of minute_offset is either not specified or is equal to zero.

Formal Propositions:

- | | |
|-----|---|
| WR1 | the hour_offset shall be a positive number less than 24. |
| WR2 | the minute offset shall be a positive number less than 59 |
| WR3 | If the value of sense specifies that there is no offset from the Coordinated Universal Time then the hour_offset and the actual_minute_offset shall both be equal to zero. If either hour_offset or the actual_minute_offset are different from zero then the value of sense shall be specified to show that there is an offset either ahead or behind from the Universal Coordinated Time. |

4.2.3 Application objects for the approval UoF

This subclause specifies the data types and application objects associated with the approval UoF. For the EXPRESS-G ARM diagram for this clause, see Annex G, Figure G.3.

4.2.3.1 affected_item_select

An affected_item_select is a select data type that provides a mechanism for associating an instance of either Approval or Certificate with an instance of one of:

- Activity_type;
- Document_version;
- Individual_activity;
- Individual_product;
- Organisation;
- Person_in_organisation;
- Product_type.

EXPRESS specification:

```

*)

```

```
TYPE affected_item_select = SELECT
  (Activity_type,
   Document_version,
   Individual_activity,
   Individual_product,
   Product_type,
   Organisation,
   Person_organisation);
END_TYPE;
(*
```

4.2.3.2 AP_qualification_type

An AP_qualification_type is the identification of a formal capability and authority.

EXPRESS specification:

```
*)
ENTITY AP_qualification_type;
name      : STRING;
description : STRING;
END_ENTITY;
(*
```

Attribute definitions:

name : label by which the qualification is known

description : further information about the nature of the qualification

4.2.3.3 Approval

An Approval is formal confirmation of an activity or item of product data

EXPRESS specification:

```
*)
ENTITY Approval;
defined_in      : Certificate;
status          : Approval_status;
purpose         : STRING;
approval_date : Calendar_date;
authorised_by : Approving_person_organisation;
END_ENTITY;
(*
```

Attribute definitions:

defined_in: document where the approval is recorded

status: user interpretable designation of the level of approval

purpose: text specifying the reason or intention of the approval

approval_date: point in time when the approval was performed

authorised_by: person and organisation responsible for granting an Approval

4.2.3.4 Approval_assignment

An Approval_assignment is a mechanism for the association of an Approval with an activity or with product data.

EXPRESS specification:

```
*)
  ENTITY Approval_assignment;
    assigned_approval      : Approval;
    items                  : SET [1:?] OF affected_item_select;
    role                   : STRING;
  END_ENTITY;
(*
```

Attribute definitions:

assigned_approval: approval that is assigned with activity or product data

items: activity or product data to which the approval is assigned

role: text that describes the function of the approval with respect to the items to which it is assigned

4.2.3.5 Approval_relationship

An Approval_relationship is an association between two instances of Approval.

EXPRESS specification:

```
*)
  ENTITY Approval_relationship;
    relating_approval      : Approval;
    related_approval       : Approval;
    relation_type           : STRING;
    description            : STRING;
  END_ENTITY;
(*
```

Attribute definitions:

relating_approval: one of the Approval objects that is part of the relationship

related_approval: One of the Approval objects that is part of the relationship.

NOTE If one element of the relationship is dependent on the other then this attribute is the dependent one.

relation_type: text that identifies the meaning of the relationship

Where applicable the following values of relation_type shall be used:

- 'decomposition': identifies a relationship where the related Approval is one of the components into which the relating Approval is broken down with no implication of 'sequence' or 'dependency'.

- 'dependency' : identifies a relationship where the issuing of the related Approval is dependent upon the relating Approval.
- 'precedence': identifies a relationship where the related Approval has a higher priority than the relating Approval.
- 'sequence': identifies a relationship where the relating Approval shall be completed before the related Approval is given.

NOTE The value 'dependency' does not imply the meaning of the values 'decomposition' or 'sequence'

EXAMPLE 1 The Approval of an Activity can be dependent on the Approval of all of the constituent parts of the Activity.

EXAMPLE 2 The Approval of an Activity in a sequence of activities can depend on the prior approval of a preceding Activity.

description: text that provides further information about the Approval_relationship

4.2.3.6 Approval_status

An Approval_status is a particular rank or importance of Approval.

EXPRESS specification:

```
*)
  ENTITY Approval_status;
    status_name : STRING;
  END_ENTITY;
(*
```

Attribute definitions:

status_name: text that describes the Approval_status

EXAMPLE 'approved' or 'not approved' are examples of Approval_status.

4.2.3.7 Approving_person_organisation

An Approving_person_organisation is an association between an Approval and the person or organisation that has granted the Approval.

EXPRESS specification:

```
*)
  ENTITY Approving_person_organisation;
    role : STRING;
    qualification : AP_qualification_type;
    approved_by : person_organisation;
  END_ENTITY;
(*
```

Attribute definitions:

role: description of the function of the considered person or organisation with respect to an Approval.

qualification: reference to the formal authority for providing an Approval

approved_by: reference to the person or organisation responsible for an Approval

4.2.3.8 Certificate

A Certificate is a record of approval.

EXPRESS specification:

```
*)
ENTITY Certificate;
  cert_id      : STRING;
  cert_name    : STRING;
  cert_date    : Calendar_date;
  issued_by    : person_organisation;
END_ENTITY;
(*
```

Attribute definitions:

cert_id: identifier for a Certificate

cert_name: label that identifies the type of certificate

cert_date: calendar date when the certificate was issued

issued_by: identification of the person or organisation responsible for the issue of a Certificate

4.2.3.9 Certificate_assignment

A Certificate_assignment is a mechanism for specifying an association between a record of approval and the objects that are approved.

EXPRESS specification:

```
*)
ENTITY Certificate_assignment;
  assigned_certificate      : Certificate;
  certificated_items       : SET [1:?] OF affected_item_select;
  role                     : STRING;
END_ENTITY;
(*
```

Attribute definitions:

assigned_certificate: identification of the record of approval

certificated_items: set of objects that are approved

role: purpose of the association

4.2.3.10 Security_classification

A Security_classification is a type of Approval that defines the conditions of access.

EXPRESS specification:

```
*)
  ENTITY Security_classification
  SUBTYPE OF (Approval);
  classification_level      : STRING;
  description               : STRING;
  END_ENTITY;
(*
```

Attribute definitions:

classification_level: text that defines the conditions of access

EXAMPLE 'confidential' is a value of classification_level that can be applied to messages

description: text to provide further information about the conditions of access

4.2.4 Application objects for the condition UoF

This subclause specifies the data types and application objects associated with the condition UoF. For the EXPRESS-G ARM diagram for this clause, see Annex G, Figure G.4.

4.2.4.1 condition_evaluation_item

A condition_evaluation_item is an extensible select data type for instances of objects that are to be included in the Condition_evaluation.

NOTE The list can be extended by applications that implements this document.

An instance of Condition_evaluation may be associated with one of:

- Approval;
- Individual_activity;
- Individual_product.

EXPRESS specification:

```
*)
  TYPE condition_evaluation_item = SELECT
    (Individual_product,
     Individual_activity,
     Approval);
  END_TYPE;
(*
```

4.2.4.2 conditioned_item

A conditioned_item is an extensible select data type for instances of items to which a Condition is

assigned.

NOTE The list can be extended by applications that implements this document.

An instance of Condition may be associated with an instance of:

- Approval;
- Individual_activity;
- Individual_product.

EXPRESS specification:

```
*)
  TYPE conditioned_item = SELECT
    (Individual_product,
     Individual_activity,
     Approval);
  END_TYPE;
(*
```

4.2.4.3 Condition

A Condition is a state that shall exist before something else is possible.

EXPRESS specification:

```
*)
  ENTITY Condition;
    description          : STRING;
    name                 : STRING;
    defined_state: State_type;
  END_ENTITY;
(*
```

Attribute definitions:

description: text describing an instance of Condition

name: label by which a Condition is known

defined_state: reference to the state that shall be satisfied

4.2.4.4 Condition_assignment

A Condition_assignment provides a mechanism for the association of a Condition with product or activity data.

NOTE Condition_assignment represents the consequences of Condition.

EXPRESS specification:

```
*)
  ENTITY Condition_assignment;
```

```
assigned_condition      : Condition;
assigned_item           : conditioned_item;
END_ENTITY;
(*
```

Attribute definitions:

assigned_condition: the instance of Condition that is being assigned

assigned_item: product or activity data to which the Condition is being assigned

4.2.4.5 Condition_evaluation

A Condition_evaluation is the record of the evaluation of a Condition and the subsequent result.

EXPRESS specification:

```
*)
ENTITY Condition_evaluation;
condition      : Condition;
description    : STRING;
name           : STRING;
evaluation_state : State_type;
END_ENTITY;
(*
```

Attribute definitions:

condition: instance of Condition that has been evaluated

description: text to provide information about the result of the Condition_evaluation

NOTE Possible outcomes of an evaluation and their meanings are:

- 'TRUE' - the condition was satisfied;
- 'FALSE' - the condition was not satisfied;
- 'NOT KNOWN' - the result of the evaluation was not measured.

name: label by which the Condition_evaluation is known

evaluation_state: the state of the object at the time of the evaluation

4.2.4.6 Condition_evaluation_assignment

A Condition_evaluation_assignment provides a mechanism for the association of a Condition_evaluation with product or activity data.

NOTE A Condition_evaluation_assignment represents the consequence of the Condition_evaluation.

EXPRESS specification:

```
*)
ENTITY Condition_evaluation_assignment;
assigned_condition_evaluation : Condition_evaluation;
item: condition_evaluation_item;
```

```
END_ENTITY;
( *
```

Attribute definitions:

assigned_condition_evaluation: instance of Condition_evaluation that is being assigned

item: product or activity data to which the Condition_evaluation is being assigned

4.2.4.7 Condition_relationship

A Condition_relationship is an association between two instances of Condition.

NOTE A Condition_relationship normally represents a logical combination of conditions.

EXAMPLE ' If the engine has been running for 1000 hours AND if the oil filter has a lifetime of 1 000 hours then change the oil filter' is an example of two conditions related by a logical AND.

EXPRESS specification:

```
*)
ENTITY Condition_relationship;
  relating_condition      : Condition;
  related_condition      : Condition;
  relation_type          : STRING;
  description            : STRING;
END_ENTITY;
( *
```

Attribute definitions:

relating_condition: one of the instances of Condition that participates in the relationship

related_condition: the other instance of Condition that participates in the relationship

NOTE 1 If one element of the relationship is dependent on the other then this attribute is the dependent one.

relation_type: text that defines the meaning of the relationship

description: text to describe the Condition relationship

NOTE 2 The value of this attribute need not be specified.

4.2.5 Application objects for the document_management UoF

This subclause specifies the data types and application objects associated with the document_management UoF. For the EXPRESS-G ARM diagram for this clause, see Annex G, Figure G.5.

4.2.5.1 documented_items

A documented_items is an extensible select data type that provides a list of alternatives with which a Document can be selectively associated.

Document may be associated with an instance of:

- Activity_type;
- Individual_activity;
- Individual_product;
- Product_type.

EXPRESS specification:

```
*)
  TYPE documented_items = SELECT
    (Individual_activity,
     Individual_product,
     Activity_type,
     Product_type);
  END_TYPE;
(*
```

4.2.5.2 external_identification_item

An external_identification_item is an extensible select data type that provides a list of alternatives from which an instance of External_source_identification can be selected.

NOTE The list can be extended by applications that implements this document.

External_source_identification can be associated with an instance of:

- Document_definition;
- Document_location_identification;
- File;
- File_location_identification.

EXPRESS specification:

```
*)
  TYPE external_identification_item = EXTENSIBLE SELECT
    (File,
     Document_definition,
     Document_location_identification,
     File_location_identification);
  END_TYPE;
(*
```

4.2.5.3 Digital_document_definition

A Digital_document_definition is a type of Document_definition that defines a digital electronic form.

EXPRESS specification:

```
*)
  ENTITY Digital_document_definition
  SUBTYPE OF (Document_definition);
  END_ENTITY;
```