
Cutting tool data representation and exchange —

Part 1: Overview, fundamental principles and general information model

*Représentation et échange des données relatives aux outils
coupants —*

*Partie 1: Vue d'ensemble, principes fondamentaux et modèle général
d'informations*



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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 13399-1 was prepared by Technical Committee ISO/TC 29, *Small tools*.

ISO 13399 consists of the following parts, under the general title *Cutting tool data representation and exchange*:

- *Part 1: Overview, fundamental principles and general information model*
- *Part 2: Reference dictionary for the cutting items* [Technical Specification]
- *Part 100: Definitions, principles and methods for reference dictionaries* [Technical Specification]

The following parts are under preparation:

- *Part 3: Reference dictionary for the tool items* [Technical Specification]
- *Part 4: Reference dictionary of terms for adaptive items* [Technical Specification]
- *Part 50: Reference dictionary for reference systems and common concepts* [Technical Specification]
- *Part 60: Reference dictionary for connection systems* [Technical Specification]

Assembly items is to form the subject of a future Part 5.

Introduction

ISO 13399 provides the means to achieve an electronic representation of cutting tool data by providing the information structure needed to describe various data about cutting tools and cutting tool assemblies. It is intended to facilitate the use, manipulation and exchange of cutting tool data within and between manufacturing, distribution, and usage.

A cutting tool with defined cutting edges is used on a machine tool to remove workpiece material through a shearing action at the cutting edge(s) of the tool. Cutting tool data are characteristics of the cutting tool and its use that must be known and evaluated in order to make manufacturing decisions and to perform manufacturing operations.

ISO 13399 includes the data representation of everything between the workpiece and the machine tool. Information about inserts, solid tools (e.g. solid drill and solid endmill), assembled tools (e.g. boring bars, indexable drills and indexable milling cutters), adaptors (e.g. milling arbor and chucks), components (e.g. shims, screws and clamps) or any combination of the above can be exchanged.

The cutting tool data described include, but are not limited to, geometrical and dimensional data, identification and designation data, miscellaneous and spare part data, cutting material data, and component connectivity.

The use of the tool information model established by ISO 13399 will provide increased productivity for the user in the same way as do the tools. The effective management of tool information will improve the management of the tools themselves. Use of the tool information model will enable the identification of the “right” tool in every operation — from tool purchase, through planning, set-up in machine-tools, maintenance and reuse of the tools — with short lead times and with high reliability and product quality. Tool users will benefit from improved support from the tool vendors who will be able to provide a standard information product to accompany the tool products. Computer interfaces for information exchange will be more efficient.

The representation of product data is defined by ISO 10303, which specifies the computer-interpretable representation of product information and the exchange of product data. The objective is to provide a neutral mechanism capable of describing products throughout their life cycle. This mechanism is suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases, and as a basis for archiving (ISO 10303-1).

This part of ISO 13399 uses the following resources according to ISO 10303:

- a) the EXPRESS language defined in ISO 10303-11;
- b) the file format for data exchange defined in ISO 10303-21 and ISO 10303-28;
- c) the integrated resources given in parts ISO 10303-40 to ISO 10303-56.

ISO 13399 is intended for use by manufacturers, tool vendors or producers, and developers of manufacturing software, among others. It provides a common structure for exchanging data about cutting tools (see Figure 1), and is intended to allow or improve several capabilities, including

- provision of a common set of definitions for use in describing cutting tools and cutting tool assemblies,
- the integration and sharing of cutting tool and assembly data between software applications,
- direct import of vendor cutting tool data into customer databases or applications, and
- a reduction in the level of effort required for manufacturers to maintain accurate and current cutting tool information from multiple sources and for multiple applications.

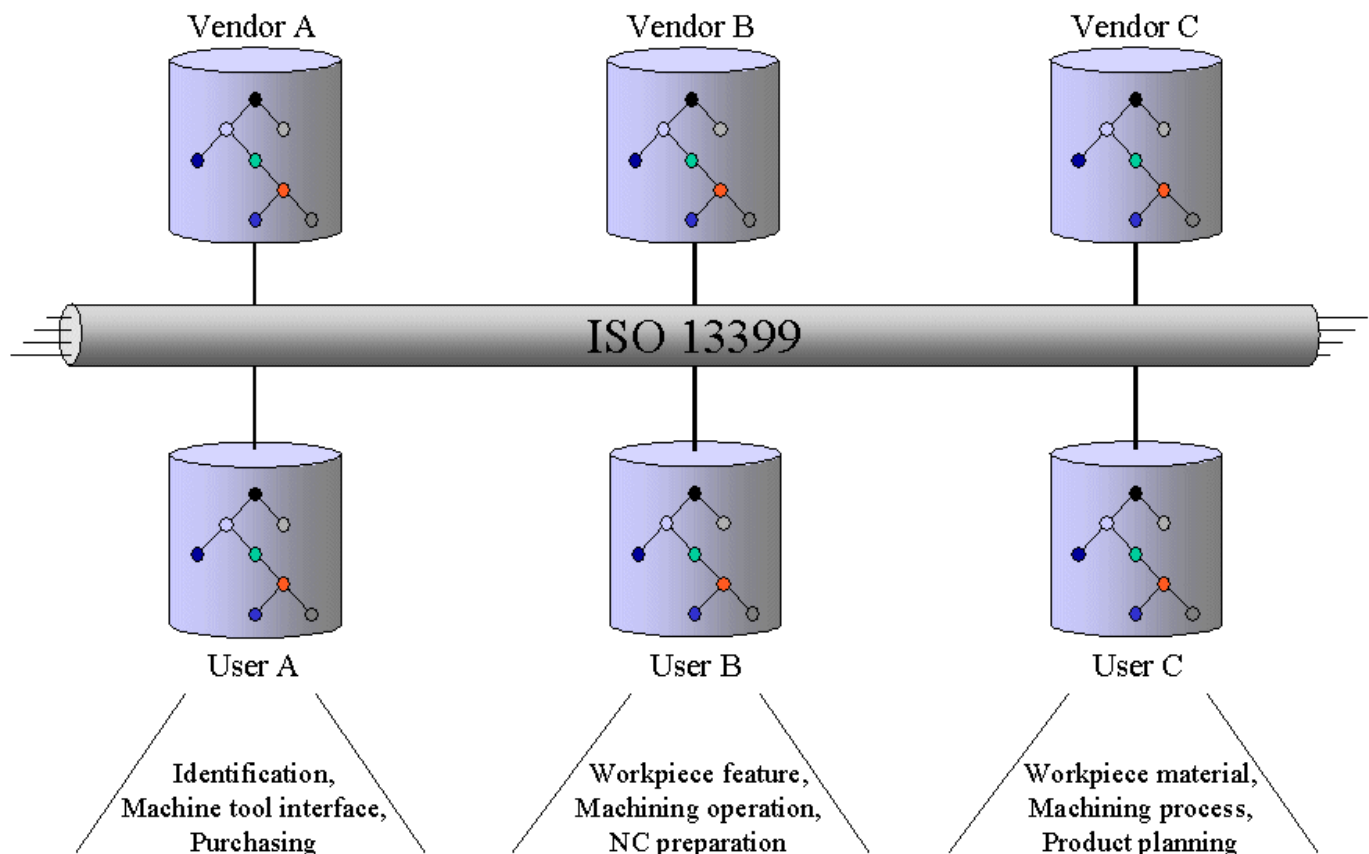


Figure 1 — Role of ISO 13399 in communication of cutting tool data and potential user viewpoints

While the use of ISO 13399 can facilitate the creation of an electronic catalogue, it does not set forth the rules or procedures for creating electronic catalogues. These are defined in ISO 13584.

The responsibility for providing different viewpoints lies outside the scope of ISO 13399. Viewpoints might be the material to be cut, the shape to be produced, the application for which the tool will be used or any other valid viewpoint.

NOTE Use of the modelled information for different purposes can be regarded as different viewpoints of the information. Although ISO 13399 does not provide the viewpoints, the information may be viewed from several alternative viewpoints (see Figure 1).

Different companies use different business models to determine their need for the communication of information about their products. For example, one cutting tool manufacturer could regrind its customers' tools while another could allow its customers to do the regrinding and provide the information to enable them to do so. Therefore, the two cutting tool manufacturers could have a different set of cutting tool properties to communicate using the information model and dictionaries provided by ISO 13399.

ISO 13399 defines only that information which could be communicated; it not specify what information must be communicated.

Cutting tool data representation and exchange —

Part 1: Overview, fundamental principles and general information model

1 Scope

This part of ISO 13399 covers the main categories of cutting tool data and the relationships between them. It provides a general information model of data representation and information exchange for these categories, as well as an overview of the principles of product data exchange used in ISO 13399 as a whole, a description of the other parts of ISO 13399 and a method for transferring cutting tool data.

The following is not covered by this part of ISO 13399:

- general data transfer and representations other than cutting tool data;
- data describing rules, guidelines and expert knowledge used to design and manufacture machined parts and cutting tools;
- data describing why a particular design or manufacturing decision was made.

Cutting tool data and exchange for specific items (cutting, tool, adaptive and assembly items) and the classification and definition of terms used in the description of cutting tools are defined in the other parts of ISO 13399, respectively, and referenced by them.

ISO 13399 establishes a means of communicating industrial data between different computer systems that is independent of any proprietary system.

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.

ISO 639-2, *Codes for the representation of names of languages — Part 2: Alpha-3 code*

ISO 3002-1, *Basic quantities in cutting and grinding — Part 1: Geometry of the active part of cutting tools — General terms, reference systems, tool and working angles, chip breakers*

ISO 3002-3, *Basic quantities in cutting and grinding — Part 3: Geometric and kinematic quantities in cutting*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

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 10303-44, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resource: Product structure configuration*

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

ISO 10303-46, *Industrial automation systems and integration — Product data representation and exchange — Part 46: Integrated generic resources: Visual presentation*

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

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

ISO 10303-214, *Industrial automation systems and integration — Product data representation and exchange — Part 214: Application protocol: Core data for automotive mechanical design processes*

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 part families*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13399-100 and the following apply.

3.1 cutting tool

device or assembly of items for removing material from a workpiece through a shearing action at the defined cutting edge or edges of the device

NOTE A cutting tool could be the assembly of one or more adaptive items, a tool item and several cutting items on a tool item. See Figure 3.

3.2 information model

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

NOTE See Reference [3].

NOTE “An information model is a formal description of types of ideas, facts and processes which together form a model of a portion of interest of the real world and which provides an *explicit set of interpretation rules*. (If an information model is written in EXPRESS or any other computer-sensible representation, it has the additional quality of being computer processible.)”^[9].

4 Fundamental concepts and assumptions

ISO 13399 does not standardize cutting tools but the representation of information about cutting tools. Any standard dealing with information representation must be designed with the intent to standardize the *description* of the items that the standard deals with and not to standardize the items themselves. This method is also a step towards having standards that are not made obsolete by developments within the area where the standard applies ^[10].

The intent of ISO 13399 is achieved by means of a computer-processable information model that defines the framework within which data values can be placed. The benefits of such an information model are that it can be interpreted by different computer applications and be generic enough to describe many different kinds of tools. The aim of ISO 13399 is to allow for the different tools and machining operations that can be expected in the future, while meeting the needs of current types of tool and their uses. It should also be possible to describe a tool independently of its use, since the combination of modern tools and machines may allow a tool to be used for many different kinds of cutting operation.

ISO 13399 specifies the representation of information on

- cutting tools,
- cutting items,
- tool items,
- adaptive items, and
- assembly items.

See Figure 2.

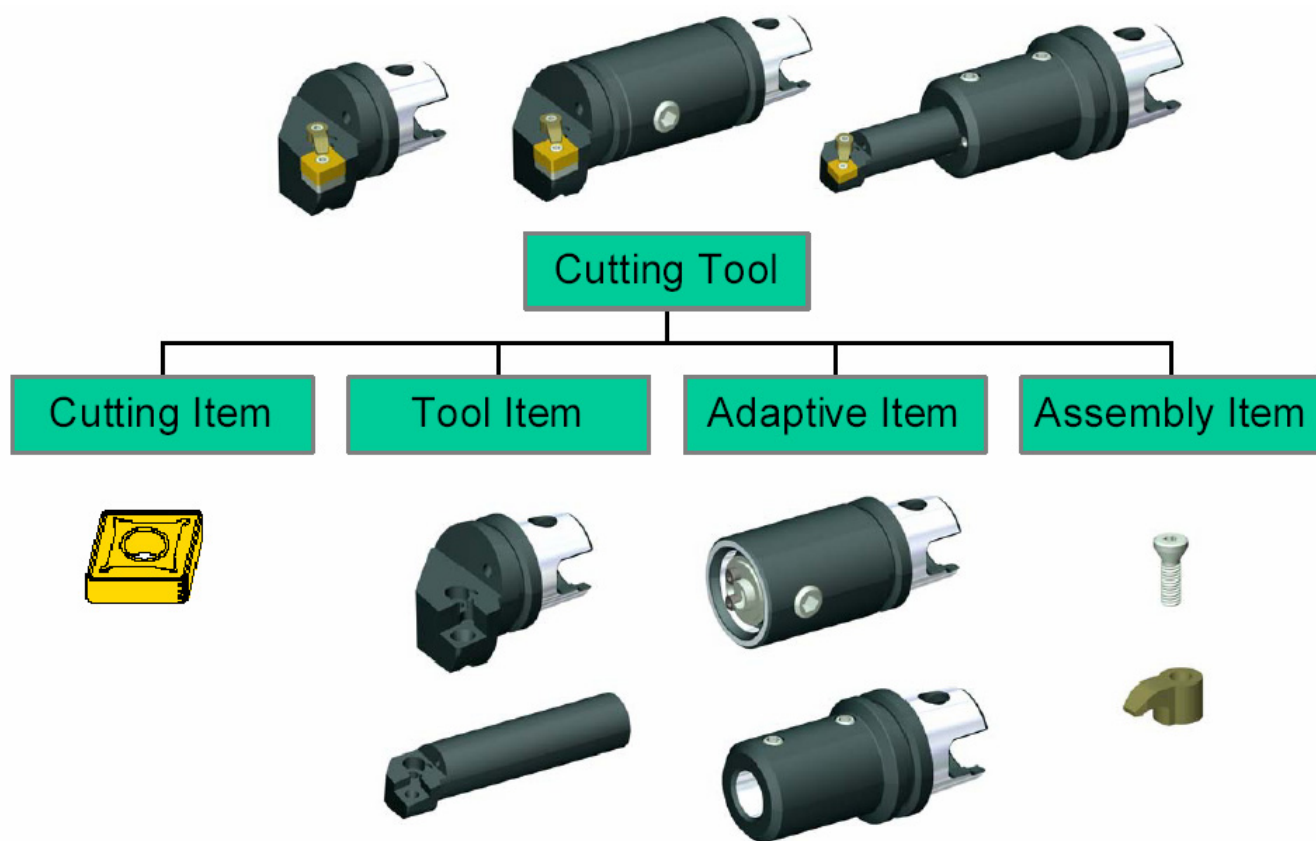


Figure 2 — Examples of the main groups

The definitions of these groups are given in their respective parts of ISO 13399. Different combinations of these groups are shown in Figure 3.

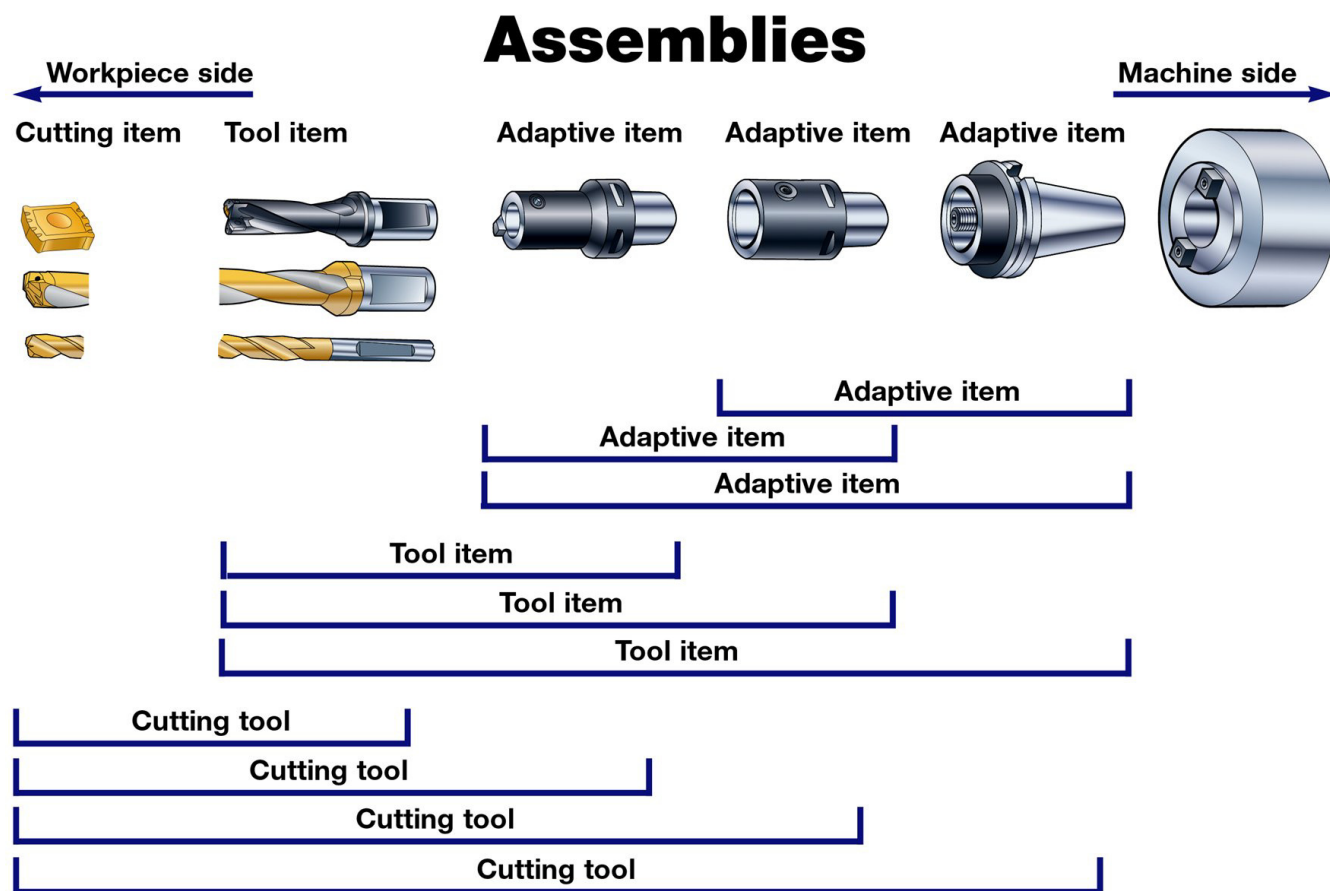


Figure 3 — Examples of different types of assemblies of items

The allowed relationships between these groups are shown in Table 1.

Table 1 — Matrix of Combinations

		Machine side		
		Tool item	Adaptive item	Assembly item
Workpiece side	Cutting item	X		X
	Tool item	X	X	X
	Adaptive item		X	X
	Assembly item	X	X	X

ISO 13399 does not deal with how to construct a cutting tool item, but provides an information representation for cutting tools. Tools may be classified according to any scheme, and viewed from many viewpoints.

5 Information requirements

5.1 Units of Functionality

5.1.1 classification

This unit of functionality provides the capability to classify items into specific categories.

EXAMPLE Examples are the classification as raw materials, parts, or tools, or as safety or in-process items.

Additionally items may be classified by their attributes.

EXAMPLE Examples for categories of attribute based classification are screws, bolts, nuts, shafts, or brackets.

The following application objects are used by the classification UoF:

- classification_association
- classification_association_relationship
- classification_attribute
- classification_system
- din4000_reference
- external_library_reference
- general_classification
- general_classification_hierarchy
- plib_class_reference
- plib_property_reference
- specific_item_classification
- specific_item_classification_hierarchy

5.1.2 dimension_tolerance

This unit of functionality specifies the representation of geometric dimensions and of tolerances limiting geometric dimensions. Tolerances for geometric dimensions are characterized by plus-minus-tolerances, limits and fits, dimension ranges, or dimension limits and describe the allowable deviation range.

The following application objects are used by the dimension_tolerance UoF:

- limits_and_fits
- plus_minus_bounds
- value_limitation

5.1.3 effectivity

This unit of functionality provides the capability to represent information concerning the validity of data. Implicit propagation of data specifying validity is not available.

The validity of data can be expressed by effectivities that specify time ranges within which data may be used.

The following application objects are used by the effectivity UoF:

- duration
- effectivity
- effectivity_assignment
- effectivity_relationship

5.1.4 external_reference_mechanism

This unit of functionality provides a reference mechanism to specify external documents that are associated with objects defined in this part of ISO 13399. These documents may contain data that are not in scope of this part of ISO 13399. This includes conventional non-digital data and digital data in other computer interpretable formats.

EXAMPLE Technical drawings on paper, standards documents, or hand-written documents, are examples of non-digital data referenced by the external reference mechanism.

EXAMPLE CAD data in a system's native format, text documents in SGML, or NC-data in ISO 6983 are examples of digital data referenced by the external reference mechanism.

The following application objects are used by the external_reference_mechanism UoF:

- cartesian_coordinate_space
- cartesian_coordinate_space_2d
- cartesian_coordinate_space_3d
- digital_document
- digital_file
- document
- document_assignment
- document_content_property
- document_creation_property
- document_file
- document_format_property
- document_location_property
- document_representation

- document_size_property
- document_type_property
- document_version
- document_version_relationship
- external_file_id_and_location
- external_geometric_model
- external_model
- external_picture
- geometric_model_relationship_with_transformation
- named_size
- physical_document
- physical_file
- rectangular_size
- transformation
- transformation_2d
- transformation_3d

5.1.5 individual_definition_structure

The following application objects are used by the individual_definition_structure UoF:

- physical_item_definition
- physical_item_structure_association

5.1.6 individual_management_data

The following application objects are used by the individual_management_data UoF:

- item_version_relationship
- location
- physical_item
- physical_item_definition
- physical_item_location_association
- physical_item_state_association
- physical_item_structure_association

- physical_item_version
- realized_item_association
- state

5.1.7 item_definition_structure

This unit of functionality provides the capability to represent relationships between items to build up various kinds of structures.

The structures are defined for item definitions, for item instances that are particular occurrences of item definitions or between item definitions and item instances.

Among these structures is a hierarchical assembly structure to represent the relationships between constituents and the assembly.

The following application objects are used by the item_definition_structure UoF:

- assembly_association
- assembly_definition
- item_definition_relationship
- item_instance
- item_structure_association
- mated_item_relationship
- mating_association
- mating_definition
- quantified_instance

5.1.8 item_property

This unit of functionality specifies various properties for a part, such as material, recyclability, mass, and general properties.

The information about recyclability is required to describe whether and how material or component parts may be reused. The costs, as planned or calculated for a part, as well as a quality measure property to keep track of the results of some processes, e.g., prototype building, may be specified. The mass is required to express the weight of a part. Shape related properties that are rotation and translation invariant such as the centre of mass and the moments of inertia may also be specified.

The general properties are required to define property data which are not covered by one of the other UoFs, and, due to their variety, cannot be specified all by explicit application objects.

EXAMPLE Noise development of an engine, maintenance intervals of parts, and heat or noise absorption of insulating parts between the engine and passenger compartment are examples for general properties.

The following application objects are used by the item_property UoF:

- coating

- coupling
- cutting_condition
- cutting_data_association
- grade
- grade_relationship
- item_characteristic_association
- item_property_association
- material_designation
- property
- property_relationship
- property_value_association
- property_value_representation
- property_value_representation_relationship
- substrate
- workpiece_feature

5.1.9 product_management_data

This unit of functionality provides the capability to represent product management information. It includes information about items that are either raw materials, parts, or tools, about versions and views of items, and about persons and dates.

Additionally, this unit of functionality provides the capability to represent descriptive information about objects in different languages and to assign alias identifiers to objects.

The following application objects are used by the product_management_data UoF:

- alias_identification
- application_context
- date_time
- item
- item_definition
- item_version
- item_version_relationship
- language

- multi_language_string
- numerical_value
- organization
- person
- person_in_organization
- person_organization_assignment
- property_value
- specific_item_classification
- specific_item_classification_hierarchy
- string_value
- string_with_language
- unit
- value_limit
- value_list
- value_range
- value_with_unit

5.2 Application objects

SCHEMA ISO13399_1;

5.2.1 default_language_string

EXPRESS specification:

```
TYPE default_language_string = STRING;
END_TYPE;
```

5.2.2 alias_select

EXPRESS specification:

```
TYPE alias_select = SELECT
  (item,
   item_version,
   item_definition,
   property,
   grade,
   classification_attribute,
   classification_system,
   document,
   document_representation,
```

```
document_version,  
general_classification,  
item_instance,  
organization,  
document_type_property);  
END_TYPE;
```

5.2.3 assigned_document_select

EXPRESS specification:

```
TYPE assigned_document_select = SELECT  
  (document_version,  
   document);  
END_TYPE;
```

5.2.4 classification_source_select

EXPRESS specification:

```
TYPE classification_source_select = SELECT  
  (plib_class_reference,  
   document,  
   external_library_reference);  
END_TYPE;
```

5.2.5 classified_element_select

EXPRESS specification:

```
TYPE classified_element_select = SELECT  
  (item_version,  
   item,  
   item_definition,  
   document,  
   property,  
   property_value_association,  
   item_instance,  
   document_file,  
   document_version,  
   document_representation,  
   material_designation);  
END_TYPE;
```

5.2.6 documented_element_select

EXPRESS specification:

```
TYPE documented_element_select = SELECT  
  (item,  
   item_version,  
   classification_attribute,  
   classification_system,  
   item_definition,  
   general_classification,  
   item_structure_association,  
   item_instance,
```

```

organization,
person,
property,
specific_item_classification,
material_designation,
mated_item_relationship,
physical_item_structure_association);
END_TYPE;

```

5.2.7 effective_element_select

EXPRESS specification:

```

TYPE effective_element_select = SELECT
  (document,
  classification_system,
  document_file,
  document_representation,
  document_version,
  item,
  item_version,
  item_instance,
  property,
  property_value_association,
  material_designation,
  item_structure_association,
  realized_item_association,
  physical_item_state_association,
  physical_item_location_association,
  physical_item_structure_association);
END_TYPE;

```

5.2.8 general_organizational_data_select

EXPRESS specification:

```

TYPE general_organizational_data_select = SELECT
  (classification_association,
  classification_system,
  item_definition,
  document,
  document_file,
  document_representation,
  document_version,
  general_classification,
  item,
  item_structure_association,
  item_instance,
  item_version,
  item_version_relationship,
  person_in_organization,
  property,
  property_value_association,
  material_designation,
  physical_item_structure_association);
END_TYPE;

```

5.2.9 item_characteristic_select

EXPRESS specification:

```
TYPE item_characteristic_select = SELECT
    (cutting_condition,
     coupling,
     workpiece_feature,
     material_designation,
     cutting_data_association,
     grade);
END_TYPE;
```

5.2.10 item_property_select

EXPRESS specification:

```
TYPE item_property_select = SELECT
    (item_definition,
     item_characteristic_select,
     document_file,
     document_representation,
     item_structure_association,
     item_instance,
     mated_item_relationship,
     physical_item_structure_association);
END_TYPE;
```

5.2.11 limitation_definition_select

EXPRESS specification:

```
TYPE limitation_definition_select = SELECT
    (limits_and_fits,
     plus_minus_bounds);
END_TYPE;
```

5.2.12 person_organization_select

EXPRESS specification:

```
TYPE person_organization_select = SELECT
    (organization,
     person_in_organization);
END_TYPE;
```

5.2.13 property_source_select

EXPRESS specification:

```
TYPE property_source_select = SELECT
    (plib_property_reference,
     external_library_reference,
     document);
END_TYPE;
```

5.2.14 string_select

EXPRESS specification:

```
TYPE string_select = SELECT
    (default_language_string,
     multi_language_string);
END_TYPE;
```

5.2.15 alias_identification

An *alias_identification* is a mechanism to associate an object with an additional identifier that is used to identify the object of interest in a different context, either in another organization, or in some other context. The scope of the *alias_identification* shall be specified either by the attribute 'alias_scope' or by the attribute 'description'.

EXAMPLE A document (e.g., a book) may have a unique document id (ISBN) and an *alias_identification* as inventory number in the context of the inventory of a company.

EXPRESS specification:

```
ENTITY alias_identification;
    alias_id          : STRING;
    alias_scope       : OPTIONAL organization;
    alias_version_id  : OPTIONAL STRING;
    description       : OPTIONAL string_select;
    is_applied_to     : alias_select;
END_ENTITY;
```

5.2.15.1 alias_id

The *alias_id* specifies the identifier used in the context specified by the *alias_scope*, or by the description.

5.2.15.2 alias_scope

The *alias_scope* specifies the organization in which the *alias_identification* is valid.

The *alias_scope* need not be specified for a particular *alias_identification*.

5.2.15.3 alias_version_id

The *alias_version_id* specifies the version of the object as known in the context of the *alias_identification*.

NOTE An *alias_version_id* may be applied even if the object of interest does not have versions.

The *alias_version_id* need not be specified for a particular *alias_identification*.

5.2.15.4 description

The description specifies the type of the *alias_identification*.

EXAMPLE The description may be, e.g., 'inventory number'.

The description need not be specified for a particular *alias_identification*.

If present, there shall be exactly one object that defines the description for an *alias_identification*.

5.2.15.5 is_applied_to

The is_applied_to specifies the object that has an alias_identification.

5.2.16 application_context

An application_context is a shared universe of discourse.

EXPRESS specification:

```
ENTITY application_context;  
    application_domain    :    STRING;  
    description           :    OPTIONAL string_select;  
END_ENTITY;
```

5.2.16.1 application_domain

The application_domain is the identification of the applications for which an object may be relevant.

Where applicable the following values shall be used:

'machining':	The object may be relevant for machining;
'manufacturing simulation':	The object may be relevant for manufacturing simulation.
'nc preparation':	The object may be relevant for nc preparation.
'process planning':	The object may be relevant for process planning.
'product planning':	The object may be relevant for product planning.
'purchasing':	The object might be relevant for purchasing;

5.2.16.2 description

The description specifies additional information about the application_context.

The description need not be specified for a particular application_context.

If present, there shall be exactly one object that defines the description for a application_context.

5.2.17 assembly_association

An assembly_association is the relation between an assembly_definition and an item_instance representing a constituent of the assembly. The assembly_definition and the item_definition that serves as 'definition' of the item_instance shall share at least one context.

NOTE The constituent may also be an assembly.

EXPRESS specification:

```
ENTITY assembly_association  
    SUBTYPE OF(item_structure_association);  
    SELF\item_structure_association.relatng    :    assembly_definition;  
END_ENTITY;
```

5.2.17.1 relating

The relating specifies the assembly_definition that has subordinate constituents.

5.2.18 assembly_definition

An assembly_definition is a definition of an item_version that contains other subordinate objects.

An assembly_definition is a type of item_definition.

EXPRESS specification:

```
ENTITY assembly_definition
  SUBTYPE OF (item_definition);
  assembly_type : OPTIONAL STRING;
END_ENTITY;
```

5.2.18.1 assembly_type

The assembly_type specifies the kind of the assembly_definition.

EXAMPLE 'functional assembly', 'manufacturing assembly', and 'design assembly' are examples of an assembly_type.

5.2.19 cartesian_coordinate_space

A cartesian_coordinate_space is a coordinate space in which geometric and annotation elements may be defined. It is either two-dimensional or three-dimensional. An origin for coordinate values is implicitly defined. The units applicable to the coordinate values of elements defined in the cartesian_coordinate_space are specified.

NOTE Cartesian transformation objects are used to specify the relationships between coordinate spaces.

Each cartesian_coordinate_space is a cartesian_coordinate_space_3d or a cartesian_coordinate_space_2d.

EXPRESS specification:

```
ENTITY cartesian_coordinate_space
  ABSTRACT SUPERTYPE OF (ONEOF (cartesian_coordinate_space_2d,
    cartesian_coordinate_space_3d));
  unit_of_values : OPTIONAL SET [2:?] OF unit;
END_ENTITY;
```

5.2.19.1 unit_of_values

The unit_of_values specifies the various units in which any values are expressed. In the case where geometric elements are defined in the cartesian_coordinate_space, there shall be at least two units specified, the length unit and the plane angle unit. The same length unit is applied to each coordinate direction. Only one unit of a kind shall be specified.

NOTE If elements with different units are required, they have to be separated into different models with their own cartesian_coordinate_space.

EXAMPLE A length measure unit measured in inches and an angle measure unit measured in degrees are examples for two members of the attribute unit_of_values assigned to the same cartesian_coordinate_space.

The unit_of_values need not be specified for a particular cartesian_coordinate_space.

5.2.20 cartesian_coordinate_space_2d

A cartesian_coordinate_space_2d is a two-dimensional coordinate space. Any two-dimensional geometric and annotation element shall be defined in a cartesian_coordinate_space_2d.

A cartesian_coordinate_space_2d is a type of cartesian_coordinate_space.

EXPRESS specification:

```
ENTITY cartesian_coordinate_space_2d
  SUBTYPE OF (cartesian_coordinate_space);
END_ENTITY;
```

5.2.21 cartesian_coordinate_space_3d

A cartesian_coordinate_space_3d is a three-dimensional coordinate space. Any three-dimensional geometric data shall be defined in a cartesian_coordinate_space_3d.

A cartesian_coordinate_space_3d is a type of cartesian_coordinate_space.

EXPRESS specification:

```
ENTITY cartesian_coordinate_space_3d
  SUBTYPE OF (cartesian_coordinate_space);
END_ENTITY;
```

5.2.22 classification_system

A classification_system is the scheme used to define the categorization of an item.

EXAMPLE A dictionary collecting the conventional definitions of technical properties is an example of classification_system.

EXPRESS specification:

```
ENTITY classification_system;
  description      : OPTIONAL string_select;
  id               : STRING;
INVERSE
  allowed_classification : SET OF general_classification FOR
  used_classification_system;
END_ENTITY;
```

5.2.22.1 description

The description specifies additional information about the classification_system.

The description need not be specified for a particular classification_system.

If present, there shall be exactly one object that defines the description for a classification_system.

5.2.22.2 id

The id specifies the identifier of the classification_system.

5.2.23 classification_association

A classification_association associates a general_classification with an object.

EXPRESS specification:

```
ENTITY classification_association;
```

```

associated_classification : general_classification;
classified_element       : classified_element_select;
defintional             : OPTIONAL BOOLEAN;
role                    : OPTIONAL STRING;
END_ENTITY;

```

5.2.23.1 associated_classification

The associated_classification specifies the general_classification object that provides classification information.

5.2.23.2 classified_element

The classified_element specifies the object that is classified.

There shall be exactly one object that defines the classified_item for a classification_association.

5.2.23.3 defintional

The defintional specifies whether a general_classification serves as definition. A value of 'true' indicates that the general_classification is defintional. The 'associated_classification' does not take precedence over the descriptions of the 'classified_element' made using property_value objects.

The attribute defintional shall only be used, if the classified_element is of one of the types material_designation, item, item_version, or item_definition.

The defintional need not be specified for a particular classification_association.

5.2.23.4 role

The role specifies the relationship between the general_classification and the associated item.

The role need not be specified for a particular classification_association.

5.2.24 classification_association_relationship

A classification_association_relationship is a relationship between two classification_association objects.

EXPRESS specification:

```

ENTITY classification_association_relationship;
related          : classification_association;
relating         : classification_association;
relationship_type : STRING;
END_ENTITY;

```

5.2.24.1 related

Specifies the second general_classification that is part of the classification_relationship

5.2.24.2 relating

Specifies the first general_classification that is part of the classification_relationship

5.2.24.3 relationship_type

Specifies the type of relationship represented by the classification_relationship

Where applicable the following values shall be used:

'combination': specifies that the object being classified, by the general_classification objects that are a part of the classification_relationship, is classified as being a combination of the general_classification objects.

'alternative': specifies that the object being classified can be considered as being either one or the other of the participating general_classifications.

5.2.25 classification_attribute

A classification_attribute is a characteristic used to classify an object associated with the corresponding general_classification. The definition attribute of each 'allowed_value' shall refer to the property identified within 'attribute_definition'.

EXPRESS specification:

```
ENTITY classification_attribute;  
    allowed_value          : SET OF property_value_representation;  
    associated_classification : general_classification;  
    attribute_definition    : property;  
    description            : OPTIONAL string_select;  
    id                     : STRING;  
    name                   : OPTIONAL string_select;  
END_ENTITY;
```

5.2.25.1 allowed_value

The allowed_value specifies the set of property_value_representation objects that represent characteristic values of the classification_attribute.

5.2.25.2 associated_classification

The associated_classification specifies the general_classification the classification_attribute is a characteristic of.

5.2.25.3 attribute_definition

The attribute_definition specifies the property that characterizes the allowed values.

NOTE The specification of compound characteristics can be realized by using property_relationship with 'relation_type' set to 'peer' or 'decomposition'.

5.2.25.4 description

The description specifies additional information about the classification_attribute.

The description need not be specified for a particular classification_attribute.

If present, there shall be exactly one object that defines the description for a classification_attribute.

5.2.25.5 id

The id specifies the identifier of the classification_attribute that shall be unique within the scope of the associated general_classification.

EXAMPLE 'a' or 'b' for length or width attributes or 'r' for radius attributes are examples for identifiers of classification_attribute objects. The meaning of such ids is usually specified in external sources.

5.2.25.6 name

The name specifies the word or group of words by which the classification_attribute is referred to.

EXAMPLE 'length', 'width', or 'radius' are examples for the name of a classification_attribute.

The name need not be specified for a particular classification_attribute.

If present, there shall be exactly one object that defines the name for a classification_attribute.

5.2.26 coating

EXPRESS specification:

```
ENTITY coating;
    coating_name      : STRING;
    coating_process   : STRING;
END_ENTITY;
```

5.2.27 coupling

EXPRESS specification:

```
ENTITY coupling;
    coupling_type     : STRING;
    pieces            : OPTIONAL numerical_value;
    side              : STRING;
    size              : numerical_value;
    style             : STRING;
END_ENTITY;
```

5.2.27.1 coupling_type

Mount style may be one of:

Code	Description
0	Other clamping systems, not listed below
1	Without fixing hole [ISO 1832:1991]
2	With cylindrical fixing hole [ISO 1832:1991]
3	With partly cylindrical fixing hole, countersink on one side only [ISO 1832:1991]
4	With partly cylindrical fixing hole, countersinks on both sides [ISO 1832:1991]
5	With notch clamping
6	With convex prismatic cross section
7	With concave prismatic cross section

5.2.27.2 size

The size of the coupling.

EXAMPLE diameter of a through hole.

5.2.28 cutting_condition

Conditions relevant to the cutting process, e.g. finishing, roughing, interrupted cut, smooth cut. There may be more than one cutting_condition relevant for any item.

EXPRESS specification:

```
ENTITY cutting_condition;  
    condition_name      :   STRING;  
END_ENTITY;
```

5.2.29 cutting_data_association

Cutting data is information about the cutting conditions and performance of the cutting tool.

NOTE Certain cutting data only appear through the combination of different items, machine tools and workpieces.

EXPRESS specification:

```
ENTITY cutting_data_association;  
    associated_material  :   material_designation;  
    depth_of_cut        :   value_with_unit;  
    feed                :   value_with_unit;  
    speed               :   value_with_unit;  
END_ENTITY;
```

5.2.29.1 associated_item

Specifies one or more items associated with the cutting data.

5.2.29.2 associated_material

Specifies the workpiece_material associated with the cutting data.

5.2.29.3 depth_of_cut

Specifies the perpendicular distance between the original and final surfaces of the workpiece.

5.2.29.4 feed

Specifies the feed according to ISO 3002-3.

5.2.29.5 speed

Specifies the cutting speed according to ISO 3002-1

5.2.30 date_time

A date_time is the specification of a date and an optional time of day.

EXPRESS specification:

```
ENTITY date_time;  
    date :   STRING;  
    time :   OPTIONAL STRING;  
END_ENTITY;
```

5.2.30.1 date

The date specifies the calendar time, defined according to the Gregorian calendar, conveying information about the year, the month, and the day in no specific order. The representation of a date shall be complete, i.e., millenium, century, and year-within-century data shall be included.

5.2.30.2 time

The time specifies a moment of occurrence measured by hour, minute, and second.

The time need not be specified for a particular date_time.

5.2.31 digital_document

A digital_document is a piece of product data that is archived in a digital format.

A digital_document is a type of document_representation.

EXPRESS specification:

```
ENTITY digital_document
  SUBTYPE OF (document_representation);
  file : SET OF digital_file;
END_ENTITY;
```

5.2.31.1 file

The file specifies a computer interpretable realization of the digital_document.

5.2.32 digital_file

A digital_file contains computer interpretable data.

A digital_file is a type of document_file.

EXPRESS specification:

```
ENTITY digital_file
  SUBTYPE OF (document_file);
  INVERSE
    associated_model_space : SET OF external_model FOR is_defined_as;
END_ENTITY;
```

5.2.33 din4000_reference

DIN 4000 reference is the information about the comparability of a property between the ISO 13399 standard and the DIN 4000 standard For the reference description the properties DIN 4000 - Part No and characteristics code no is required.

EXPRESS specification:

```
ENTITY din4000_reference
  SUBTYPE OF (external_library_reference);
  characteristics_code_no : STRING;
  part_no : STRING;
END_ENTITY;
```

5.2.34 document

A document is a logical document that serves as the identifier for a container for some product data.

EXAMPLE A document can either be any kind of drawing, solid model, or visible information about the item that is geometrically described with the properties of the ISO 13399.

EXPRESS specification:

```
ENTITY document;
  description      : OPTIONAL string_select;
  document_id      : STRING;
  name             : string_select;
INVERSE
  associated_version : SET [1:?] OF document_version FOR
  associated_document;
END_ENTITY;
```

5.2.34.1 description

The description specifies additional information about the document.

The description need not be specified for a particular document.

If present, there shall be exactly one object that defines the description for a document.

5.2.34.2 document_id

The document_id specifies the identifier of the document.

5.2.34.3 name

The name specifies the word or group of words by which the document is referred to.

There shall be exactly one object that defines the name for a document.

5.2.35 document_assignment

A document_assignment is a mechanism to associate a document with an object, where the assigned document provides information about the object it is associated to.

EXPRESS specification:

```
ENTITY document_assignment;
  assigned_document : assigned_document_select;
  is_assigned_to    : documented_element_select;
  role              : STRING;
END_ENTITY;
```

5.2.35.1 assigned_document

The assigned_document specifies a document, or a document_version that is used to provide information.

There shall be exactly one object that defines the assigned_document for a document_assignment.

5.2.35.2 is_assigned_to

The is_assigned_to specifies the object that information is provided for.

There shall be exactly one object that the document_assignment is_assigned_to.

5.2.35.3 role

The role specifies the meaning of the document_assignment.

Where applicable the following values shall be used:

'additional information': The assigned document provides information that is relevant for the associated object, but is not a description of the associated object itself;
 'behavior': The assigned document specifies information about the behaviour of the associated object;
 'description': The assigned document provides textual information for the associated object itself;
 'informative': The assigned document may or may not be considered;
 'mandatory': The associated object shall conform to the content of the assigned document;
 'mathematical description': The assigned document specifies the associated object by providing the algorithmic specification of its behavior.

5.2.36 document_content_property

A document_content_property specifies characteristics precisising the content of a document_file or of a document_representation. At least one of the optional attributes shall be specified for each instance of this object.

In the case where a document_content_property is referred by a document_representation, the characteristics apply to all individual document_file objects, whereas in the case where it is referred by a document_file, the characteristics apply on an individual basis.

EXPRESS specification:

```
ENTITY document_content_property;
    detail_level      : OPTIONAL STRING;
    geometry_type     : OPTIONAL STRING;
    languages         : SET OF language;
    real_world_scale  : OPTIONAL numerical_value;
END_ENTITY;
```

5.2.36.1 detail_level

The detail_level specifies the level of detail that the document_file or the document_representation provides.

Where applicable the following values shall be used:

'rough 3d shape': 3D shape model without edge rounds and fillets;
 'rounded edges': 3D shape model with edge rounds and fillets.

The detail_level need not be specified for a particular document_content_property.

5.2.36.2 geometry_type

The geometry_type specifies the kind or kinds of geometry that an object contains.

Where applicable the following values shall be used:

'3D wireframe model': The document contains a 3D shape model in wireframe representation;
 '2D shape': The document contains a 2D shape model or contours only;
 'surface model': The document contains a 3D shape model in surface representation;
 'closed volume': The document contains a 3D shape model in closed body topological surface representation;
 'solid model': The document contains a 3D shape model in advanced boundary representation;
 'solid and surface model': The document contains a 3D shape model in surface and advanced boundary representation;

'assembly': The document contains an assembly structure with reference to the assembled components and their transformation matrices;
'assembly with mating elements': The document contains an assembly structure including the mating components only, such as screws or rivets, with exact positioning information. This assembly representation is intended to be overlayed with the assembly structure for the main components;
'2D drawing': The document contains a technical drawing without 3D shape representation;
'drawing derived from 3D data': The document contains a technical drawing that has been derived from a 3D shape model;
'drawing related to 3D data': The document contains a technical drawing that visualizes a 3D shape model and possibly establishes associative links to the 3D shape model.

The geometry_type need not be specified for a particular document_content_property.

5.2.36.3 languages

The languages specifies which language or languages are used in the characterized objects.

EXAMPLE 'Japanese' and 'German' are examples for the fact that annotation on a drawing is provided in the language 'Japanese' or 'German' respectively.

5.2.36.4 real_world_scale

The real_world_scale specifies the scale that is used in the document_file or in the document_representation the document_content_property is referred by.

The real_world_scale need not be specified for a particular document_content_property.

5.2.37 document_creation_property

A document_creation_property specifies characteristics of document_file or of document_representation objects. It specifies the context of the creation of the object. At least one of the optional attributes shall be specified for each instance of this object.

In the case where a document_creation_property is referred by a document_representation the characteristics apply to all individual document_file objects, whereas in the case it is referred by a document_file, the characteristics apply on an individual basis.

EXPRESS specification:

```
ENTITY document_creation_property;  
    creating_interface : OPTIONAL STRING;  
    creating_system    : STRING;  
    operating_system   : OPTIONAL STRING;  
END_ENTITY;
```

5.2.37.1 creating_interface

The creating_interface specifies the computer application used to create the document_file or document_representation object.

EXAMPLE 'Postscript Printer Driver' is an example for a creating interface of a physical_document.

The creating_interface need not be specified for a particular document_creation_property.

5.2.37.2 creating_system

The creating_system specifies the computer application or the machine which is used to create the object that is characterized.

5.2.37.3 operating_system

The operating_system specifies the operating system that is used to execute the computer application that created the characterized object.

The operating_system need not be specified for a particular document_creation_property.

5.2.38 document_file

A document_file is one of potentially more files on a computer system or in actual stacks of paper that make up a document_representation.

EXPRESS specification:

```
ENTITY document_file
  ABSTRACT SUPERTYPE OF (ONEOF(digital_file, physical_file));
  content                : OPTIONAL document_content_property;
  creation                : OPTIONAL document_creation_property;
  document_file_type     : OPTIONAL document_type_property;
  external_id_and_location : SET OF external_file_id_and_location;
  file_format            : OPTIONAL document_format_property;
  file_id                : STRING;
  size                   : OPTIONAL document_size_property;
  version_id             : OPTIONAL STRING;
END_ENTITY;
```

5.2.38.1 content

The content characterizes the content of the document_file.

The content need not be specified for a particular document_file.

5.2.38.2 creation

The creation specifies further details of the context of the creation of the document_file.

The creation need not be specified for a particular document_file.

5.2.38.3 document_file_type

The document_file_type specifies the format of the document_file. It shall only be specified, if the document_file does not participate in a document.

The document_file_type need not be specified for a particular document_file.

5.2.38.4 external_id_and_location

The external_id_and_location specifies alternatives of the identifier and location of the document_file.

EXAMPLE A copy of a document may be found in another department with a different id.

5.2.38.5 file_format

The file_format specifies the characteristics of the document_file that specify the format of the object.

The file_format need not be specified for a particular document_file.

5.2.38.6 file_id

The file_id specifies the identifier which is used to locate the file either on a computer system or in a repository of paper documents.

5.2.38.7 size

The size specifies characteristics for the size of the document_file.

The size need not be specified for a particular document_file.

5.2.38.8 version_id

The version_id specifies the identification of the version that distinguishes one document_file object from other versions of document_file objects with the same file_id.

The version_id need not be specified for a particular document_file.

5.2.39 document_format_property

A document_format_property specifies characteristics of a document_file or of a document_representation that specify the format of the object. At least one of the optional attributes shall be specified for each instance of this object.

In the case where a document_format_property is referred by a document_representation, the characteristics apply to all individual document_file objects, whereas in the case it is referred by a document_file the characteristics apply on an individual basis.

EXPRESS specification:

```
ENTITY document_format_property;  
    character_code      : OPTIONAL STRING;  
    data_format         : OPTIONAL STRING;  
    size_format         : OPTIONAL rectangular_size;  
END_ENTITY;
```

5.2.39.1 character_code

The character_code specifies the character code that is used in the characterized object.

Where applicable the following values shall be used:

'binary': The document contains data in binary format;
'IEC 61286': The coded character set used to encode the document data according to IEC 61286;
'ISO 646': The coded character set used to encode the document data according to ISO 646;

NOTE The character set in ISO 646 is identical to the character set commonly known as ASCII

'ISO 3098-1': The coded character set used to encode the document data is according to ISO 3098-1;
'ISO 6937': The coded character set used to encode the document data is according to ISO/IEC 6937;
'ISO 8859-1': The coded character set used to encode the document data according to ISO 8859-1;

NOTE The character set in ISO 8859-1 is identical to the character set commonly known as LATIN-1.

'ISO 10646': The coded character set used to encode the document data according to ISO/IEC 10646.

The character_code need not be specified for a particular document_format_property.

5.2.39.2 data_format

The data_format specifies the convention that was used to structure the information in the characterized object.

Where applicable the following values shall be used:

'DXF':	The document contains data in Drawing Exchange File format;
'IGES':	The document contains data in Initial Graphics Exchange Specification format;
'ISO 10303-203':	The document contains data in ISO 10303-203 format;
'ISO 10303-214':	The document contains data in ISO 10303-214 format;
'TIFF CCITT GR4':	The document contains data in TIFF CCITT GR4 format;
'VDAFS':	The document contains data in VDAFS format;
'VOXEL':	The document contains data in VOXEL format.

The data_format need not be specified for a particular document_format_property.

5.2.39.3 size_format

The size_format specifies the dimensions of a physical presentation of the object the size_format is provided for.

EXAMPLE 'ISO A0' is an example for the size_format of a drawing that is stored digitally.

The size_format need not be specified for a particular document_format_property.

5.2.40 document_location_property

A document_location_property specifies where a document_file or a document_representation can be found in a digital or physical data storage system.

In the case where a document_location_property is referred by a document_representation, the characteristics apply to all individual objects, whereas in the case it is referred by a document_file, the characteristics apply on an individual basis.

EXPRESS specification:

```
ENTITY document_location_property;
    location_name : STRING;
END_ENTITY;
```

5.2.40.1 location_name

The location_name specifies the location, where the object that refers to the document_location_property, can be found. 'C:\mpbs\programs' and '/usr/local/bin' are examples for a location_name.

NOTE Multiple paths may be specified for a single object, e.g., a database in the context of an electronic vault.

EXAMPLE The linking mechanism of many operating systems allows references to a single object from various places in the file system without copying its contents.

5.2.41 document_representation

A document_representation is one of potentially more alternative representations of a document.

EXAMPLE A logical document, which contains a shape model, may be represented in the different native formats of two 3D CAD systems.

Each document_representation is a digital_document or a physical_document.

EXPRESS specification:

```
ENTITY document_representation
  ABSTRACT SUPERTYPE OF (ONEOF(digital_document, physical_document));
  associated_document_version : document_version;
  common_location             : SET OF document_location_property;
  content                     : OPTIONAL document_content_property;
  creation                    : OPTIONAL document_creation_property;
  description                  : OPTIONAL string_select;
  id                           : STRING;
  representation_format       : OPTIONAL document_format_property;
  size                        : OPTIONAL document_size_property;
END_ENTITY;
```

5.2.41.1 associated_document_version

The associated_document_version specifies the version of the logical document that is being represented.

5.2.41.2 common_location

The common_location specifies the location of a document_representation, where all its constituents can be found.

NOTE Different common locations represent alternative representations of the same physical location.

5.2.41.3 content

The content specifies characteristics of the content of the document_representation.

The content need not be specified for a particular document_representation.

5.2.41.4 creation

The creation specifies further details of the creation of the document_representation.

The creation need not be specified for a particular document_representation.

5.2.41.5 description

The description specifies additional information about the document_representation.

The description need not be specified for a particular document_representation.

If present, there shall be exactly one object that defines the description for a document_representation.

5.2.41.6 id

The id specifies the identifier of the document_representation.

5.2.41.7 representation_format

The `representation_format` specifies the format of the document represented by `document_representation`.

The `representation_format` need not be specified for a particular `document_representation`.

5.2.41.8 size

The `size` specifies the size of the represented document.

The `size` need not be specified for a particular `document_representation`.

5.2.42 document_size_property

A `document_size_property` specifies the size of a `document_file` or of a `document_representation` object. At least one of the optional attributes shall be specified for each instance of this object.

In the case where a `document_size_property` is referred by a `document_representation`, the size information is the sum of the sizes of all individual objects that are collected by this object, whereas in the case it is referred by a `document_file`, the size information is the one of the individual objects that is referenced.

EXPRESS specification:

```
ENTITY document_size_property;
    file_size      : OPTIONAL value_with_unit;
    page_count     : OPTIONAL value_with_unit;
END_ENTITY;
```

5.2.42.1 file_size

The `file_size` specifies the `value_with_unit` that represents the size of a digitally stored document. The `file_size` shall only be applied in cases where the `document_size_property` is referred by a `digital_document` or a `document_file`.

EXAMPLE '15021 Bytes' and 'less than 500 Bytes' are examples for a `file_size`.

The `file_size` need not be specified for a particular `document_size_property`.

5.2.42.2 page_count

The `page_count` specifies the number of pages of the application object the `document_size_property` is referred by. The `page_count` shall only be used in cases where the `document_size_property` is referred by a `physical_file` or a `physical_document`.

EXAMPLE '42 pages' and 'more than 1 page' are examples of a `page_count`.

The `page_count` need not be specified for a particular `document_size_property`.

5.2.43 document_type_property

A `document_type_property` specifies the kind of a `document_file`.

EXPRESS specification:

```
ENTITY document_type_property;
    document_type_name      : STRING;
    used_classification_system : OPTIONAL classification_system;
END_ENTITY;
```

5.2.43.1 document_type_name

The document_type_name specifies the word or the group of words that describe the kind of object the characteristics are provided for.

Where applicable the following values shall be used:

'geometry':	The document represents a shape model;
'NC data':	The document represents numerical control data;
'FE data':	The document represents finite element data;
'sample data':	The document represents measured data;
'process plan':	The document represents process planning data;
'check plan':	The document represents quality control planning data;
'drawing':	The document represents a technical drawing.

5.2.43.2 used_classification_system

The used_classification_system specifies the classification_system the document_type_name is defined in.

EXAMPLE A document_type_property may be used with 'specification type 1' and 'specification type 2' as values for the attribute 'document_type_name' due to a company wide definition. By inclusion of these types in a general_classification with name 'specification' and description 'specification of company XY' these types of documents are better classified and the meaning of 'specification type 1' and 'specification type 2' can be further detailed in an attached document to the general_classification or by a reference to a classification_system for document types with that organization.

The used_classification_system need not be specified for a particular document_type_property.

5.2.44 document_version

A document_version is a release of a document.

EXPRESS specification:

```
ENTITY document_version;  
    associated_document : document;  
    description         : OPTIONAL string_select;  
    id                  : STRING;  
END_ENTITY;
```

5.2.44.1 associated_document

The associated_document specifies the logical document the document_version is a version of.

5.2.44.2 description

The description specifies additional information about the document_version.

The description need not be specified for a particular document_version.

If present, there shall be exactly one object that defines the description for a document_version.

5.2.44.3 id

The id specifies the identifier of the document_version. The id shall be unique within the scope of the associated document.

5.2.45 document_version_relationship

A document_version_relationship is a relationship between two document_version objects.

EXPRESS specification:

```
ENTITY document_version_relationship;
  description      : OPTIONAL string_select;
  related          : document_version;
  relating         : document_version;
  relation_type    : STRING;
END_ENTITY;
```

5.2.45.1 description

The description specifies additional information about the document_version_relationship.

The description need not be specified for a particular document_version_relationship.

If present, there shall be exactly one object that defines the description for a document_version_relationship.

5.2.45.2 related

The related specifies the second of the two objects related by the document_version_relationship.

NOTE The semantics of this attribute are defined by the attribute relation_type.

5.2.45.3 relating

The relating specifies the first of the two objects related by the document_version_relationship.

NOTE The semantics of this attribute are defined by the attribute relation_type.

5.2.45.4 relation_type

The relation_type specifies the meaning of the relationship.

Where applicable the following values shall be used:

'derivation': The application object defines a deriving relationship where the related document_version is based on the relating document_version which is an earlier version of the same or of a different document;
 'hierarchy': The application object defines a hierarchical relationship where the related document_version is a sub version of the relating document_version;

EXAMPLE 'Revision 1.1' and 'revision 1.2' are examples of sub-versions of 'version 1'.

'sequence': The application object defines a version sequence where the relating document_version is the preceding version and the related document_version is the following version.

Each document shall be referred to by at most one document_version_relationship as related and a 'relation_type' of 'sequence';

'supplied document': The application object defines a relationship between two document_version objects representing the same object in different organizational contexts.

NOTE The different organizational contexts can be represented by different general organizational data associations with the related document_version objects.

5.2.46 duration

A duration is the definition of a period of time.

EXPRESS specification:

```
ENTITY duration;  
    time      :   STRING;  
    time_unit :   STRING;  
END_ENTITY;
```

5.2.46.1 time

The time specifies the extend of the duration.

5.2.46.2 time_unit

The time_unit specifies the unit in which the time is specified.

5.2.47 effectivity

An effectivity is the identification of the valid use of an aspect of product data tracked by date or event.

NOTE An instance of effectivity may define a period of ineffectivity, i.e., of invalid use, if it is referred to by an instance of effectivity_assignment with 'effectivity_indication' set to 'false'.

Either 'start_definition' or 'end_definition' or both shall be specified for a particular effectivity. The only exception from this rule is an effectivity that 'inherits' its interval from another effectivity through an effectivity_relationship with relation_type 'inheritance'. If a start_definition and no end_definition is specified, the period is added to start_definition in order to get the actual end of the effectivity or ineffectivity period.

NOTE If period is not specified, the effectivity or ineffectivity period is endless. If no start_definition, but an end_definition is specified, the period shall also be specified and is subtracted from end_definition in order to get the actual start of the effectivity or ineffectivity period.

NOTE This standard does not allow to specify effectivity or ineffectivity intervals which are left-unbounded. If both start_definition and end_definition are specified, the period should not be specified because of the redundancy. If specified, it shall be equal to the measure of time between the start_definition and the end_definition of the effectivity or ineffectivity period.

EXPRESS specification:

```
ENTITY effectivity;  
    concerned_organization :   SET OF organization;  
    description            :   OPTIONAL string_select;  
    effectivity_context    :   OPTIONAL STRING;  
    end_definition        :   OPTIONAL date_time;  
    id                    :   OPTIONAL STRING;  
    period                :   OPTIONAL duration;  
    start_definition      :   OPTIONAL date_time;  
    version_id            :   OPTIONAL STRING;  
END_ENTITY;
```

5.2.47.1 concerned_organization

The concerned_organization specifies the set of organization objects in which the effectivity is valid.

EXAMPLE The effectivity of the same item may be different in the various production sites of a manufacturer.

The case where the `concerned_organization` is an empty set means that the effectivity regards any organization that may consider the product data, the effectivity is applied to.

NOTE As effectivity is most of the time organization dependent, it is recommended always to populate the `concerned_organization`

5.2.47.2 description

The description specifies additional information about the effectivity.

The description need not be specified for a particular effectivity.

If present, there shall be exactly one object that defines the description for an effectivity.

5.2.47.3 effectivity_context

The `effectivity_context` specifies the life cycle stage for which the effectivity is valid.

The `effectivity_context` need not be specified for a particular effectivity.

5.2.47.4 end_definition

The `end_definition` specifies the end of the period. The bound specified by the `end_definition` is excluded from the interval of effectivity.

The `end_definition` need not be specified for a particular effectivity.

If present, there shall be exactly one object that defines the `end_definition` for an effectivity.

5.2.47.5 id

The `id` specifies the identifier of the effectivity.

The `id` need not be specified for a particular effectivity.

5.2.47.6 period

The period specifies the period of time in which the effectivity is defined, either starting at the point in time specified by '`start_definition`' or ending at the point in time specified by '`end_definition`'. period shall be specified with a positive value.

The period need not be specified for a particular effectivity.

5.2.47.7 start_definition

The `start_definition` specifies the start of the period. The bound specified by the `start_definition` is included in the interval of effectivity.

NOTE The meaning of this attribute is further detailed by the attribute role of `effectivity_assignment`.

Either `start_definition` or `end_definition` shall be specified for a particular effectivity.

The `start_definition` need not be specified for a particular effectivity.

If present, there shall be exactly one object that defines the `start_definition` for an effectivity.

5.2.47.8 version_id

The version_id specifies the identification of a particular version of the effectivity.

The version_id need not be specified for a particular effectivity.

5.2.48 effectivity_assignment

An effectivity_assignment associates an effectivity with the object whose effectivity is controlled by the associated effectivity. The association of an effectivity to product data does not imply any statement concerning the effectivity outside of the specified interval. The same applies in the absence of any assigned effectivity, i.e. no statement concerning the effectivity is implied.

EXPRESS specification:

```
ENTITY effectivity_assignment;  
    assigned_effectivity      : effectivity;  
    effective_element         : effective_element_select;  
    effectivity_indication    : BOOLEAN;  
    role                      : STRING;  
END_ENTITY;
```

5.2.48.1 assigned_effectivity

The assigned_effectivity specifies the effectivity that is assigned.

5.2.48.2 effective_element

The effective_element specifies the object that has an effectivity assigned to it.

There shall be exactly one object that defines the effective_element for an effectivity_assignment.

5.2.48.3 effectivity_indication

The effectivity_indication specifies whether the assigned_effectivity defines a period of effectivity (value equal 'TRUE') or a period of ineffectivity (value equal 'FALSE') for the effective_element. In the first case, use of the effective_element is or was valid during the considered period.

NOTE This does not imply that use of the effectivity_element is mandatory.

In the second case, use of effective_element is or was not valid during the considered period.

5.2.48.4 role

The role specifies the relationship between the effectivity and the object that has an effectivity assigned to it.

Where applicable the following values shall be used:

'actual': The actual period during which the effectivity lasted;
'planned': The period associated with the effectivity defines a planned period of time during which the associated object is or was supposed to be effective;
'required': The associated object must be kept effective for this period.

5.2.49 effectivity_relationship

An effectivity_relationship is a relationship between two effectivity objects.

NOTE Sometimes the effectivity is not dependent on particular dates but on the effectivity of other items. In this case the dates are not instantiated and there is an effectivity_relationship to the reference effectivity.

EXPRESS specification:

```
ENTITY effectivity_relationship;
  description      : OPTIONAL string_select;
  related          : effectivity;
  relating         : effectivity;
  relation_type    : STRING;
END_ENTITY;
```

5.2.49.1 description

The description specifies additional information about the effectivity_relationship.

The description need not be specified for a particular effectivity_relationship.

If present, there shall be exactly one object that defines the description for an effectivity_relationship.

5.2.49.2 related

The related specifies the second of the two effectivity objects related by the effectivity_relationship.

NOTE The semantics of this attribute are defined by the attribute 'relation_type'.

5.2.49.3 relating

The relating specifies the first of the two effectivity objects related by the effectivity_relationship.

NOTE The semantics of this attribute are defined by the attribute 'relation_type'.

5.2.49.4 relation_type

The relation_type specifies the meaning of the relationship.

Where applicable the following values shall be used:

'constraint': The time period between the start and end definition of the related effectivity shall be within the time period of the relating effectivity;

'inheritance': The related effectivity shall not have a 'start_definition' and 'end_definition' specified but inherits the effectivity dates from the relating effectivity.

5.2.50 external_file_id_and_location

An external_file_id_and_location specifies the location of a file in an external storage system.

EXPRESS specification:

```
ENTITY external_file_id_and_location;
  external_id      : OPTIONAL STRING;
  location         : document_location_property;
END_ENTITY;
```

5.2.50.1 external_id

The external_id specifies the identifier of a document in an external storage system.

EXAMPLE An example for external_id is 'specification.txt'.

The external_id need not be specified for a particular external_file_id_and_location.

5.2.50.2 location

The location specifies the location of the document_file in the external storage system.

EXAMPLE Examples for the location are 'D:\project1\' and '/projects/project1/'.

EXAMPLE The combination of file id and its location taken from the previous examples are 'D:\project1\specification.txt' and '/projects/project1/specification.txt' respectively.

5.2.51 external_geometric_model

An external_geometric_model is the identification of a model that contains geometry in a 3D context only.

An external_geometric_model is a type of external_model.

EXPRESS specification:

```
ENTITY external_geometric_model
  SUBTYPE OF (external_model);
  model_extent : OPTIONAL STRING;
END_ENTITY;
```

5.2.51.1 model_extent

The model_extent specifies the radius of a sphere that contains all elements of the model and whose centre is at the origin of the cartesian_coordinate_space of the external_geometric_model. The model_extent is specified using a length unit.

The model_extent need not be specified for a particular external_geometric_model.

5.2.52 external_library_reference

An external_library_reference is a mechanism to refer to an entry in an external library other than ISO 13584.

EXPRESS specification:

```
ENTITY external_library_reference;
  description : OPTIONAL string_select;
  external_id : STRING;
  library_type : STRING;
END_ENTITY;
```

5.2.52.1 description

The description specifies additional information about the external_library_reference.

The description need not be specified for a particular external_library_reference.

If present, there shall be exactly one object that defines the description for an external_library_reference.

5.2.52.2 external_id

The external_id specifies the unique identifier of the referenced entry in the external library.

5.2.52.3 library_type

The library_type specifies the type of library that is used.

5.2.53 external_model

An external_model is the identification of a model that is described in a digital_file and by the cartesian_coordinate_space that is needed to further process the externally described information.

Each external_model is an external_picture or an external_geometric_model.

EXPRESS specification:

```
ENTITY external_model
  ABSTRACT SUPERTYPE OF (ONEOF(external_picture,
    external_geometric_model));
  description      : OPTIONAL string_select;
  is_defined_as    : digital_file;
  is_defined_in    : cartesian_coordinate_space;
  model_id        : STRING;
END_ENTITY;
```

5.2.53.1 description

The description specifies additional information about the external_model.

The description need not be specified for a particular external_model.

If present, there shall be exactly one object that defines the description for an external_model.

5.2.53.2 is_defined_as

The is_defined_as specifies the digital_file that contains the externally defined geometry information.

5.2.53.3 is_defined_in

The is_defined_in specifies the cartesian_coordinate_space that defines the context for the externally described geometry.

5.2.53.4 model_id

The model_id specifies the identifier of the external_model.

5.2.54 external_picture

An external_picture is the identification of a model that is described by a two dimensional image.

An external_picture is a type of external_model.

EXPRESS specification:

```
ENTITY external_picture
  SUBTYPE OF(external_model);
  SELF\external_model.is_defined_in : cartesian_coordinate_space_2d;
END_ENTITY;
```

5.2.54.1 is_defined_in

The is_defined_in specifies the cartesian_coordinate_space_2d that defines the context for the externally defined geometry.

For picture formats having no explicit origin, e.g., raster format, the lower left corner is defined as the origin of the picture, the x-axis pointing to the right, the y-axis pointing to the top.

5.2.55 general_classification_hierarchy

A general_classification_hierarchy defines a hierarchical relationship between two instances of general_classification.

EXAMPLE With general_classification, part families such as screws can be classified. Additionally subclasses can be built and linked to the super-category screws, such as machine screw or self-tapping screw.

NOTE The general_classification_hierarchy is used to build up hierarchical structures of general_classification objects.

EXPRESS specification:

```
ENTITY general_classification_hierarchy;  
  sub_classification : general_classification;  
  super_classification : general_classification;  
END_ENTITY;
```

5.2.55.1 sub_classification

The sub_classification specifies the lower level of general_classification in a general_classification_hierarchy that is included in the super class.

5.2.55.2 super_classification

The super_classification specifies the higher level of general_classification in a general_classification_hierarchy that includes the sub class.

5.2.56 general_classification

A general_classification is a classification of an object which characterizes all objects of the same kind; such a classification is independent from the application of the classified object.

EXAMPLE A fastener with subclasses, such as fastener with 2 or 3 fixture holes, a bracket with subclasses, e.g., with 90 or 100 degrees bending angle, or screws with subclasses such as metal screws or machine screws are examples for general_classification.

EXAMPLE For facilitating an effective part retrieval for slotted screws, several general_classification objects may be defined to classify screws.

EXPRESS specification:

```
ENTITY general_classification;  
  classification_source : OPTIONAL classification_source_select;  
  description : OPTIONAL string_select;  
  id : STRING;  
  used_classification_system : OPTIONAL classification_system;  
  version_id : OPTIONAL STRING;  
END_ENTITY;
```

5.2.56.1 classification_source

The `classification_source` specifies the `external_library_reference` or the `plib_class_reference` that contains the specification of the `general_classification`.

The `classification_source` need not be specified for a particular `general_classification`.

If present, there shall be exactly one object that defines the `classification_source` for a `general_classification`.

5.2.56.2 description

The `description` specifies additional information about the `general_classification`.

EXAMPLE 'fastener with 2 fixture holes' or 'bracket with 90 degree bending angle' are examples for `description`.

The `description` need not be specified for a particular `general_classification`.

If present, there shall be exactly one object that defines the `description` for a `general_classification`.

5.2.56.3 id

The `id` specifies the identifier of the `general_classification`.

5.2.56.4 used_classification_system

The `used_classification_system` specifies the `classification_system` that contains the information about the definition of the classification and how to interpret the name of the `general_classification`.

The `used_classification_system` need not be specified for a particular `general_classification`.

5.2.56.5 version_id

The `version_id` specifies the identification of a particular version of the `general_classification`.

The `version_id` need not be specified for a particular `general_classification`.

5.2.57 geometric_model_relationship_with_transformation

A `geometric_model_relationship_with_transformation` is a relationship between two model objects with the additional information about a geometric transformation. This transformation defines the location and orientation of the related model relative to the relating model.

EXPRESS specification:

```
ENTITY geometric_model_relationship_with_transformation;
  description      : OPTIONAL string_select;
  model_placement  : transformation;
  related          : external_model;
  relating         : external_model;
  relation_type    : STRING;
END_ENTITY;
```

5.2.57.1 description

The `description` specifies additional information about the `geometric_model_relationship_with_transformation`.

The `description` need not be specified for a particular `geometric_model_relationship_with_transformation`.

If present, there shall be exactly one object that defines the description for a `geometric_model_relationship_with_transformation`.

5.2.57.2 `model_placement`

The `model_placement` specifies the geometric transformation that places and orients the related model relative to the relating model.

5.2.57.3 `related`

The `related` specifies the second of the two model objects related by the `geometric_model_relationship_with_transformation`.

NOTE The semantics of this attribute are defined by the attribute `relation_type`.

There shall be exactly one object that the `geometric_model_relationship_with_transformation` is related to.

5.2.57.4 `relating`

The `relating` specifies the first of the two model objects related by the `geometric_model_relationship_with_transformation`.

NOTE The semantics of this attribute are defined by the attribute `relation_type`.

There shall be exactly one object that the `geometric_model_relationship_with_transformation` is relating to.

5.2.57.5 `relation_type`

The `relation_type` specifies the meaning of the relationship.

EXAMPLE The `relation_type` may be, e.g., 'basis for' if the relating `geometric_model` provides a detailed representation of the shape of an object and if the related `geometric_model` provides an idealized representation of the shape of the same object.

5.2.58 `grade`

EXPRESS specification:

```
ENTITY grade;
    coating                : OPTIONAL coating;
    cutting_condition      : SET [1:?] OF cutting_condition;
    identifier              : STRING;
    standard_designation   : OPTIONAL STRING;
    substrate               : substrate;
    workpiece_material     : SET [1:?] OF material_designation;
END_ENTITY;
```

5.2.59 `grade_relationship`

EXPRESS specification:

```
ENTITY grade_relationship;
    related                : grade;
    relating                : grade;
    relation_type           : STRING;
END_ENTITY;
```