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

### Part 47: Integrated generic resource: Shape variation tolerances

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

*Partie 47: Ressource générique intégrée: Tolérances de variation de forme*

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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.

Draft International Standards adopted by 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.

International Standard ISO 10303-47 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

ISO 10303 consists of the following parts under the general title *Industrial automation systems and integration - Product data representation and exchange*:

- Part 1, Overview and fundamental principles;
- Part 11, Description methods: The EXPRESS language reference manual;
- Part 12, Description method: The EXPRESS-I language reference manual;
- Part 21, Implementation methods: Clear text encoding of the exchange structure;
- Part 22, Implementation method: Standard data access interface specification;
- Part 23, Implementation method: C++ language binding to the standard data access interface;
- Part 24, Implementation method: C language binding to the standard data access interface;
- Part 26, Implementation method: Interface definition language binding to the standard data access;
- Part 31, Conformance testing methodology and framework: General concepts;
- Part 32, Conformance testing methodology and framework: Requirements on testing laboratories and clients;

- Part 34, Conformance testing methodology and framework: Abstract test methods;
- Part 35, Conformance testing methodology and framework: Abstract test methods for SDAI implementations;
- Part 41, Integrated generic resources: Fundamentals of product description and support;
- Part 42, Integrated generic resources: Geometric and topological representation;
- Part 43, Integrated generic resources: Representation structures;
- Part 44, Integrated generic resources: Product structure configuration;
- Part 45, Integrated generic resource: Materials;
- Part 46, Integrated generic resources: Visual presentation;
- Part 47, Integrated generic resource: Shape variation tolerances;
- Part 49, Integrated generic resource: Process structure and properties;
- Part 101, Integrated application resource: Draughting;
- Part 104, Integrated application resource: Finite element analysis;
- Part 105, Integrated application resource: Kinematics;
- Part 106, Integrated application resource: Building construction core model;
- Part 201, Application protocol: Explicit draughting;
- Part 202, Application protocol: Associative draughting;
- Part 203, Application protocol: Configuration controlled design;
- Part 204, Application protocol: Mechanical design using boundary representation;
- Part 205, Application protocol: Mechanical design using surface representation;
- Part 207, Application protocol: Sheet metal die planning and design;

- Part 208, Application protocol: Life cycle management - Change process;
- Part 209, Application protocol: Composite and metallic structural analysis and related design;
- Part 210, Application protocol: Electronic assembly, interconnect, and packaging design;
- Part 212, Application protocol: Electrotechnical design and installation
- Part 213, Application protocol: Numerical control process plans for machined parts;
- Part 214, Application protocol: Core data for automotive mechanical design processes;
- Part 215, Application protocol: Ship arrangement;
- Part 216, Application protocol: Ship moulded forms;
- Part 217, Application protocol: Ship piping;
- Part 218, Application protocol: Ship structures;
- Part 221, Application protocol: Functional data and their schematic representation for process plant;
- Part 222, Application protocol: Exchange of product data for composite structures;
- Part 223, Application protocol: Exchange of design and manufacturing product information for casting parts;
- Part 224, Application protocol: Mechanical product definition for process plans using machining features;
- Part 225, Application protocol: Building elements using explicit shape representation;
- Part 226, Application protocol: Ship mechanical systems;
- Part 227, Application protocol: Plant spatial configuration;
- Part 229, Application protocol: Exchange of design and manufacturing product information for forged parts;

- Part 230, Application protocol: Building structural frame: Steelwork;
- Part 231, Application protocol: Process engineering data: Process design and process specification of major equipment;
- Part 232, Application protocol: Technical data packaging core information and exchange;
- Part 301, Abstract test suite: Explicit draughting;
- Part 302, Abstract test suite: Associative draughting;
- Part 303, Abstract test suite: Configuration controlled design;
- Part 304, Abstract test suite: Mechanical design using boundary representation;
- Part 305, Abstract test suite: Mechanical design using surface representation;
- Part 307, Abstract test suite: Sheet metal die planning and design;
- Part 308, Abstract test suite: Life cycle management - Change process;
- Part 309, Abstract test suite: Composite and metallic structural analysis and related design;
- Part 310, Abstract test suite: Electronic assembly, interconnect, and packaging design;
- Part 312, Abstract test suite: Electrotechnical design and installation;
- Part 313, Abstract test suite: Numerical control process plans for machined parts;
- Part 314, Abstract test suite: Core data for automotive mechanical design processes;
- Part 315, Abstract test suite: Ship arrangement;
- Part 316, Abstract test suite: Ship moulded forms;
- Part 317, Abstract test suite: Ship piping;
- Part 318, Abstract test suite: Ship structures;
- Part 321, Abstract test suite: Functional data and their schematic representation for process plant;

- Part 322, Abstract test suite: Exchange of product data for composite structures;
- Part 323, Abstract test suite: Exchange of design and manufacturing product information for casting parts;
- Part 324, Abstract test suite: Mechanical product definition for process plans using machining features;
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- Part 330, Abstract test suite: Building structural frame: Steelwork;
- Part 331, Abstract test suite: Process engineering data: Process design and process specification of major equipment;
- Part 332, Abstract test suite: Technical data packaging core information and exchange;
- Part 501, Application interpreted construct: Edge-based wireframe;
- Part 502, Application interpreted construct: Shell-based wireframe;
- Part 503, Application interpreted construct: Geometrically bounded 2D wireframe;
- Part 504, Application interpreted construct: Draughting annotation;
- Part 505, Application interpreted construct: Drawing structure and administration;
- Part 506, Application interpreted construct: Draughting elements;
- Part 507, Application interpreted construct: Geometrically bounded surface;
- Part 508, Application interpreted construct: Non-manifold surface;

- Part 509, Application interpreted construct: Manifold surface;
- Part 510, Application interpreted construct: Geometrically bounded wireframe;
- Part 511, Application interpreted construct: Topologically bounded surface;
- Part 512, Application interpreted construct: Faceted boundary representation;
- Part 513, Application interpreted construct: Elementary boundary representation;
- Part 514, Application interpreted construct: Advanced boundary representation;
- Part 515, Application interpreted construct: Constructive solid geometry;
- Part 517, Application interpreted construct: Mechanical design geometric presentation;
- Part 518, Application interpreted construct: Mechanical design shaded representation.

The structure of this International Standard is described in ISO 10303-1. The numbering of the parts of the International Standard reflects its structure:

- Parts 11 to 12 specify the description methods,
- Parts 21 to 26 specify the implementation methods,
- Parts 31 to 35 specify the conformance testing methodology and framework,
- Parts 41 to 49 specify the integrated generic resources,
- Parts 101 to 106 specify the integrated application resources,
- Parts 201 to 232 specify the application protocols,
- Parts 301 to 332 specify the abstract test suites, and
- Parts 501 to 518 specify the application interpreted constructs.

Annexes A and B form an integral part of this part of ISO 10303. Annexes C, D, and E are for information only.

## 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, 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 data bases and archiving.

This International Standard is organized as a series of parts, each published separately. The parts of ISO 10303 fall into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, abstract test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the integrated resources series. Major subdivisions of this part of ISO 10303 are:

- shape aspect definition, provides resources for the representations of shapes to which dimensions and tolerances are applied;
- shape dimension, provides resources for the representations of size and relative location to meet the dimensioning requirements found in engineering design;
- shape tolerance, provides resources for the representations of limits within which manufactured shapes are permitted to vary.

This part of ISO 10303 supports all of the dimensioning and tolerancing methods as defined by existing International Standards on technical drawings. These methods include explicit dimensioning, associative dimensioning, plus-minus tolerancing, and geometrical tolerancing.

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

## Part 47:

## Integrated generic resource: Shape variation tolerances

### 1 Scope

This part of ISO 10303 specifies the resource constructs for representing dimensions and tolerances of product shapes. The dimensions specify the sizes of a shape and locations of identifiable portions of a shape. The tolerances specify the allowable deviation of a product from its defined shape and dimensions. The representations of dimensions and tolerances provided by this part of ISO 10303 are appropriate for use with both 2D and 3D geometric models of parts.

The following are within the scope of this part of ISO 10303:

- tolerances as constraints on the shape characteristics of a product;
- the specification of the tolerances on a defined shape;
- the representation of geometrical tolerances and plus-minus tolerances;
- the representation of tolerance values;
- the representation of dimensions;
- the assignment of size characteristics to a shape;
- the assignment of location and orientation characteristics to a shape;
- the specification of datums and datum references;
- the identification of derived shape elements such as centre lines and intersections;
- the structure for limit and fit systems for shapes.

The following are outside the scope of this part of ISO 10303:

- the definition of the fundamental principles, concepts and terminology of tolerancing and dimensioning;
- the mathematical definition of tolerances and datums;
- the description of dimensioning or tolerancing practices;
- the specification of dimensional inspection methods;
- the synthesis and analysis of tolerances;
- the tolerancing of product characteristics other than shape;
- the presentation of tolerances on engineering drawings;
- the specification of surface finish or surface roughness.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10303. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 129:1985, *Technical drawings - Dimensioning - General principles, definitions, methods of execution and special indications*.

ISO 286-1:1988, *ISO system of limits and fits - Part 1: Bases of tolerances, deviations and fits*.

ISO 286-2:1988, *ISO system of limits and fits - Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*.

ISO 406:1987, *Technical drawings - Tolerancing of linear and angular dimensions*.

ISO 1101:1983, *Technical drawings - Geometric tolerancing - Tolerancing of form, orientation, location and run-out - Generalities, definitions, symbols, indications on drawings.*

ISO 2692:1988, *Technical drawings - Geometrical tolerancing - Maximum material principle.*

ISO 5458:1987, *Technical drawings - Geometrical tolerancing - Positional tolerancing.*

ISO 5459:1981, *Technical drawings - Geometrical tolerancing - Datums and datum-systems for geometrical tolerances.*

ISO/IEC 8824-1:1995, *Information technology - Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

ISO 10303-1:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 1: Overview and fundamental principles.*

ISO 10303-11:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 11: Description methods: The EXPRESS language reference manual.*

ISO 10303-41:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 41: Integrated generic resources: Fundamentals of product description and support.*

ISO 10303-42:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 42: Integrated generic resource: Geometric and topological representation.*

ISO 10303-43:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 43: Integrated generic resources: Representation structures.*

ISO 10578:1992, *Technical drawings - Tolerancing of orientation and location - Projected tolerance zone.*

## 3 Definitions

### 3.1 Terms defined in ISO 129

This part of ISO 10303 makes use of the following terms defined in ISO 129:

— dimension;

— dimensioning;

— feature.

### 3.2 Terms defined in ISO 286-1

This part of ISO 10303 makes use of the following terms defined in ISO 286-1:

— fit system;

— hole;

— limit system;

— shaft;

— standard tolerance;

— tolerance class.

### 3.3 Terms defined in ISO 1101

This part of ISO 10303 makes use of the following terms defined in ISO 1101:

— axis;

— geometrical tolerance;

— median plane;

— projected tolerance zone;

— runout tolerance;

— symmetry;

— tolerance;

- tolerance zone;
- total runout tolerance.

### 3.4 Terms defined in ISO 2692

This part of ISO 10303 makes use of the following terms defined in ISO 2692:

- least material condition;
- maximum material condition.

### 3.5 Terms defined in ISO 5459

This part of ISO 10303 makes use of the following terms defined in ISO 5459:

- datum;
- datum feature;
- datum system;
- datum target.

### 3.6 Terms defined in ISO 10578

This part of ISO 10303 makes use of the following term defined in ISO 10578:

- projected tolerance zone.

### 3.7 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms defined in ISO 10303-1:

- application context;
- application protocol;
- product;

— resource construct;

— structure.

### 3.8 Other definitions

For the purposes of this part of ISO 10303, the following definitions apply:

**3.8.1 boundary:** the surfaces that surround and enclose the physical mass of the product shape.

**3.8.2 form tolerance:** geometric tolerance applied to a feature or single feature element that requires no datum reference.

**3.8.3 profile tolerance:** geometric tolerance applied to a uniform boundary along the true profile within which the elements of the surface must lie.

**3.8.4 plus-minus tolerance:** a tolerance that is defined by two values that represent the minimum and maximum limits of a range within which the toleranced dimension may deviate.

**3.8.5 toleranced feature:** an identifiable portion of the product shape to which one or more tolerances are applied.

## 4 Shape aspect definition

The following EXPRESS declaration begins the **shape\_aspect\_definition\_schema** and identifies the necessary external references.

### EXPRESS specification:

\*)

```
SCHEMA shape_aspect_definition_schema;
```

```
REFERENCE FROM product_property_definition_schema
  (shape_aspect,
   shape_aspect_relationship);
```

```
REFERENCE FROM measure_schema
  (measure_with_unit);
```

```
REFERENCE FROM support_resource_schema
    (bag_to_set, label, identifier);
{ *
```

NOTE - The schemas referenced above can be found in the following parts of ISO 10303:

|                                    |              |
|------------------------------------|--------------|
| product_property_definition_schema | ISO 10303-41 |
| measure_schema                     | ISO 10303-41 |
| support_resource_schema            | ISO 10303-41 |

## 4.1 Introduction

The subject of the **shape\_aspect\_definition\_schema** is to provide definitions of the spatial characteristics of a shape that are required for dimensioning and tolerancing. This schema provides representations for a **derived\_shape\_aspect** and a **datum**. A **derived\_shape\_aspect** is a **shape\_aspect** that is developed from the defined shape of the product, but that is not required for defining the product shape. A **datum** is a **shape\_aspect** that provide the origin from where dimensions and tolerances are referenced. A **derived\_shape\_aspect** and a **datum** are aspects of the shape that are required for dimensioning and tolerancing the size, the location, the orientation, and the form of a product shape.

## 4.2 Fundamental concepts and assumptions

The product shape is the concept of shape as a property that characterizes a product. Geometric models and engineering drawings are formal methods used to represent the product shape. Dimensions and tolerances are elements of the product shape definition which are independent from how the shape is represented. Dimensions may be explicitly identified as part of the shape characteristics, implicitly included in a geometric model that represents the shape, or explicitly presented in a two-dimensional drawing.

A **shape\_aspect** is an element of a product shape. Dimensions may be specified for both the entire product shape and aspects of the shape. This schema augments the **shape\_aspects** and the relationships among them as the definitional mechanism for specifying dimensions and tolerances. A **shape\_aspect**, relationships between **shape\_aspect** elements, and their specified dimensions and tolerances are always defined in the context of the product shape property. These dimensions and tolerances can be represented as elements of geometric models or engineering drawings.

For the purpose of identifying dimensions and tolerances, this schema specifies the concept of a **derived\_shape\_aspect**. A **derived\_shape\_aspect** is a **shape\_aspect** that is defined based on the specific way in which it relates to another shape aspect. The **derived\_shape\_aspect** is used in conjunction with their related **shape\_aspect** elements to specify dimensions and tolerances. The specific geometry that can represent the **derived\_shape\_aspect** and a **shape\_aspect** that provide the definitional relationship are not in the scope of this schema. The

geometry, the representation structure, and their association to the dimension and tolerance elements specified in this part are defined in ISO 10303-41, ISO 10303-42, and ISO 10303-43. Only the generic concept of derived **shape\_aspect** is specified here. Application protocols may specify additional derived **shape\_aspect** elements from those provided.

NOTE - Legal values that are computer sensible for attributes of entities in this schema may be specified in application protocols.

### 4.3 **shape\_aspect\_definition\_schema** type definition: **limit\_condition**

A **limit\_condition** type indicates that a tolerance may have a material modifier condition applied. This modifier allows for the addition of material to, or for the reduction of material from a feature. The use of **limit\_condition** applies only to toleranced features and datum features that have size characteristics.

EXAMPLE 1 - The diameter of a hole or of a shaft or the width of a slot are size characteristics which may have a **limit\_condition** applied.

#### EXPRESS specification:

```
* )
TYPE limit_condition = ENUMERATION OF
    (maximum_material_condition,
      least_material_condition,
      regardless_of_feature_size);
END_TYPE;
( *
```

#### Enumerated item definitions:

**maximum\_material\_condition:** the state of a feature when it contains its maximum material with respect to its specified limit of size. Maximum material condition is defined in clause 3.3 of ISO 2692. The methods described in ISO 2692 for applying **maximum\_material\_condition** to datums and toleranced features shall be followed.

NOTE 1 - For a **shape\_aspect** which is void of material, the **maximum\_material\_condition** is the smallest measure of this feature of size, e.g., the smallest diameter of a hole.

**least\_material\_condition:** the state of a feature when it contains its least material with respect to its specified limit of size. Least material condition is defined in clause 3.5 of ISO 2692. The methods described in amendment 1 of ISO 2692 for applying **least\_material\_condition** to datums and toleranced features shall be followed.

NOTE 2 - For a **shape\_aspect** which is void of material, the **least\_material\_condition** is the largest measure of this feature of size, e.g., the largest diameter of a hole.

**regardless\_of\_feature\_size**: the state of a feature when the specified tolerance or datum reference applies to any increment of size within the specified limits of the feature.

## NOTES

3 - Unlike **maximum\_material\_condition** and **least\_material\_condition**, **regardless\_of\_feature\_size** is not dependent on the quantity of material the feature of size contains. **regardless\_of\_feature\_size** means that when geometric tolerance is specified for a feature of size, the specified tolerance is independent of size changes in that feature of size. It does not matter if the feature of size is at its upper tolerance measure, at its lower tolerance measure or any measure between, the specified tolerance or datum reference applies.

4 - The principle of **regardless\_of\_feature\_size** is explained in clause 2.8.1, 4.4.3, 5.3.1, and 5.3.4 of ANSI Y14.5 [1].

## 4.4 shape\_aspect\_definition\_schema entity definitions: datum

### 4.4.1 datum

A **datum** is a **shape\_aspect** from which dimensions and tolerances are referenced. This **shape\_aspect** may, but need not, coincide with the boundary defining the product. A datum is established by a datum feature, a set of datum targets, or a group of features.

NOTE - The use and application of a group of features to establish a datum is identified in clause 9 of ISO 5459. The group of features is established through the use of **shape\_aspect\_relationship** objects. The concept of a group of **shape\_aspect** elements is defined in 4.5.1.

#### EXPRESS specification:

```
*)
ENTITY datum
  SUBTYPE OF (shape_aspect);
  identification : identifier;
INVERSE
  established_by_relationships : SET [1:?] OF shape_aspect_relationship
    FOR related_shape_aspect;
WHERE
```

```

WR1: SIZEOF (QUERY (X<*SELF.established_by_relationships |
    SIZEOF (TYPEOF(X.relateing_shape_aspect)*
    ['SHAPE_ASPECT_DEFINITION_SCHEMA.DATUM_FEATURE',
    'SHAPE_ASPECT_DEFINITION_SCHEMA.DATUM_TARGET'])) <> 1))=0;

```

```

END_ENTITY;
( *

```

#### Attribute definitions:

**identification:** the name by which the datum is referred.

**established\_by\_relationships:** the **datum\_feature**, the set of **datum\_targets**, or the group of derived **shape\_aspect** that establish the **datum**.

#### Formal propositions:

**WR1:** A **datum** shall be established by either **datum\_features** or **datum\_targets**.

### 4.4.2 datum\_feature

The **datum\_feature** is an identified **shape\_aspect** on the boundary of the product. One **datum\_feature** may be used to establish a single **datum**.

```

*)
ENTITY datum_feature
    SUBTYPE OF (shape_aspect);
INVERSE
    feature_basis_relationship : shape_aspect_relationship
                                FOR relating_shape_aspect;
WHERE
    WR1: SIZEOF (QUERY (sar<* bag_to_set (USEDIN (SELF,
        'PRODUCT_PROPERTY_DEFINITION_SCHEMA.SHAPE_ASPECT_RELATIONSHIP.' +
        'RELATING_SHAPE_ASPECT'))
    | NOT ('SHAPE_ASPECT_DEFINITION_SCHEMA.DATUM' IN TYPEOF
        (sar.related_shape_aspect))))=0;
    WR2: SELF.product_definitional = TRUE;
END_ENTITY;
( *

```

Attribute definitions:

**SELFshape\_aspect.product\_definitional:** an indicator that the **datum\_feature** is on the physical boundary of the shape that defines the product.

**feature\_basis\_relationship:** the relationship to the datum that the **datum\_feature** defines; it is achieved through the **shape\_aspect\_relationship**.

Formal propositions:

**WR1:** A **datum\_feature** shall be related to a **datum**.

**WR2:** A **datum\_feature** shall lie on the physical boundary of the shape that defines the product.

**EXAMPLE 2** - Figure 1 illustrates two cases of **datum\_feature**. The **datum\_feature** that is a cylindrical feature establishes the **datum** identified as A. This **datum** is the axis of the cylinder. The **datum** identified as B is established from the **datum\_feature** that is a planar surface of the product. This **datum** may, but need not, be a plane that is coincident with the **datum\_feature**.

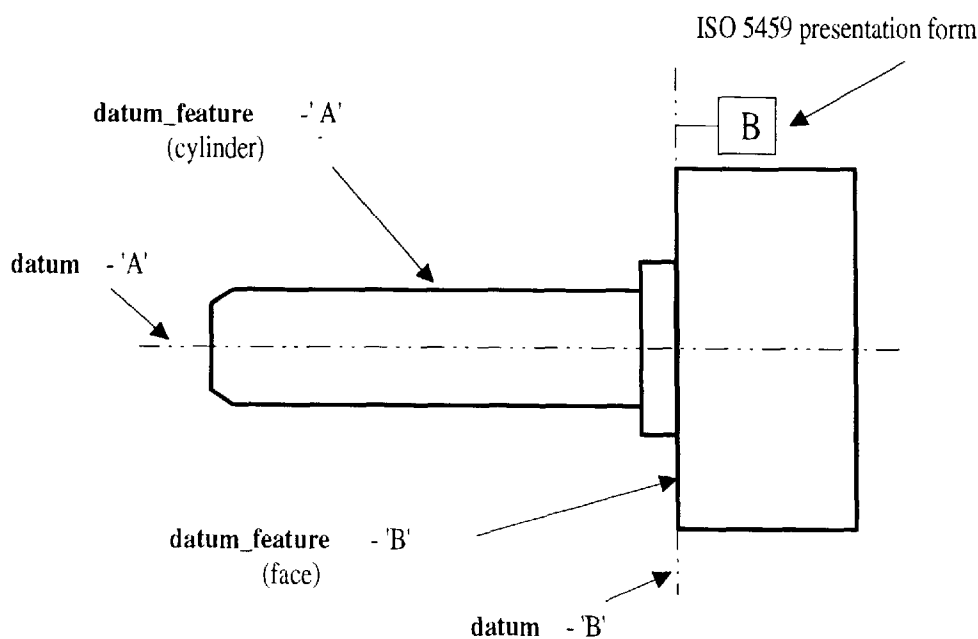


**Figure 1 - Examples of datum and datum\_feature**

### 4.4.3 datum\_target

The **datum\_target** is a **shape\_aspect** that indicates a datum target on the boundary of a product shape. The **shape\_aspect** may be a point, line, or an area. The **datum\_target** is defined in addition to the **shape\_aspect** elements that define the product shape.

NOTE - The use and application of datum targets is described in clause 7 of ISO 5459.

#### EXPRESS specification:

```

*)
ENTITY datum_target
  SUBTYPE OF (shape_aspect);
  target_id          : identifier;
  INVERSE
  target_basis_relationship : shape_aspect_relationship FOR
                           relating_shape_aspect;
WHERE
  WR1: SIZEOF (QUERY (sar<* bag_to_set (USEDIN (SELF,
    'PRODUCT_PROPERTY_DEFINITION_SCHEMA.SHAPE_ASPECT_RELATIONSHIP.' +
    'RELATING_SHAPE_ASPECT'))
    | NOT ('SHAPE_ASPECT_DEFINITION_SCHEMA.DATUM' IN TYPEOF
    (sar.related_shape_aspect))))=0;
  WR2: SELF.product_definitional = TRUE;
END_ENTITY;
(*

```

#### Attribute definitions:

**target\_id**: the name by which the identification of the datum target number is referred.

**target\_basis\_relationship**: the relationship to the **datum** that the **datum\_target** defines; it is achieved through the **shape\_aspect\_relationship**.

#### Formal propositions:

**WR1**: A **datum\_target** shall be related to a **datum**.

**WR2**: A **datum\_target** lies on the physical boundary of the shape that defines the product.

#### 4.4.4 datum\_reference

A **datum\_reference** is the specification of the use of a **datum**.

EXAMPLE 3 - A **datum** may be used in the definition of multiple **datum** systems. Each use of the **datum** would be a **datum** reference. **Datum** system concepts are described in 6.2 and clause 8 of ISO 5459.

##### EXPRESS specification:

```
* )
ENTITY datum_reference;
  precedence      : INTEGER;
  referenced_datum : datum;
WHERE
  WR1: precedence > 0;
END_ENTITY;
( *
```

##### Attribute definitions:

**precedence**: the priority that is assigned to a **datum** for a specific use.

NOTE - A **datum** may have multiple and distinct uses and have different **precedence** for each use.

**referenced\_datum**: the **datum** that participates in a geometrical tolerance of a product feature.

##### Formal propositions:

**WR1**: The value of **precedence** shall be greater than zero.

#### 4.4.5 referenced\_modified\_datum

A **referenced\_modified\_datum** is a **datum\_reference** where the referenced datum may vary within the specified limits of size.

##### NOTES

1 - A **datum** may be modified if the **datum\_feature** that produced it is a product feature which has size characteristics.

2 - The use and application of a modified **datum** are described in clause 8 of ISO 2692.

#### EXPRESS specification:

```
*)
ENTITY referenced_modified_datum
  SUBTYPE OF (datum_reference);
  modifier : limit_condition;
END_ENTITY;
( *
```

#### Attribute definitions:

**modifier:** the **limit\_condition** that is assigned to the **datum** for a specific use of that **datum**.

## 4.5 shape\_aspect\_definition\_schema entity definitions: derived shapes

### 4.5.1 composite\_shape\_aspect

A **composite\_shape\_aspect** is a **shape\_aspect** that associates aspects of the product shape for a specific purpose.

#### EXPRESS specification:

```
*)
ENTITY composite_shape_aspect
  SUBTYPE OF (shape_aspect);
INVERSE
  component_relationships : SET [2:?] OF shape_aspect_relationship
    FOR relating_shape_aspect;
END_ENTITY;
( *
```

#### Attribute definitions:

**component\_relationships:** the set of member **shape\_aspects** that form the **composite\_shape\_aspect**. The **relating\_shape\_aspect** is the **composite\_shape\_aspect**, and the **related\_shape\_aspects** are members of the set.