INTERNATIONAL STANDARD

ISO 10303-101

First edition
1994-12-15

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

Part 101:
Integrated application resources: Draughting

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

Partie 101: Ressources d'application intégrées: Dessins techniques

Reference number
ISO 10303-101:1994(E)

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International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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Foreword

The International Organization for Standardization (ISO) 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 10303-101 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data and global manufacturing languages*.

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 21, Implementation methods: Clear text encoding of the exchange structure;
- Part 22, Implementation methods: Standard data access interface;
- Part 31, Conformance testing methodology and framework: General concepts;
- Part 32, Conformance testing methodology and framework: Requirements on testing laboratories and clients;
- 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 resources: Materials;

- Part 46, Integrated generic resources: Visual presentation;
- Part 47, Integrated generic resources: Shape variation tolerances;
- Part 49, Integrated generic resources: Process structure and properties;
- Part 101, Integrated application resources: Draughting;
- Part 104, Integrated application resources: Finite element analysis;
- Part 105, Integrated application resources: Kinematics;
- Part 201, Application protocol: Explicit draughting;
- Part 202, Application protocol: Associative draughting;
- Part 203, Application protocol: Configuration controlled design;
- Part 207, Application protocol: Sheet metal die planning and design;
- Part 210, Application protocol: Printed circuit assembly product design data;
- Part 213, Application protocol: Numerical control process plans for machined parts.

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

- Part 11 specifies the description method;
- Parts 21 and 22 specify the implementation methods;
- Parts 31 and 32 specify the conformance testing methodology and framework;
- Parts 41 to 49 specify the integrated generic resources;
- Parts 101 to 105 specify the integrated application resources;
- Parts 201 to 213 specify the application protocols.

Should further parts be published, they will follow the same numbering pattern.

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

Diskette

Users should note that this part of ISO 10303 comprises a diskette:
— the short names of entities given in annex A are also included on the diskette;
— the EXPRESS listings (annex C) are provided on the diskette only;
— a method to enable users to report errors in the documentation is given. Full details are provided in the file.

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 databases 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 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 the International Standard are:

– drawing definition which specifies the resources necessary for the identification, description, organization, and administration of drawing and drawing sheet versions;

– draughting element which specifies the resources representing basic draughting elements such as dimension lines, projection lines, leader lines and the use of these resources in combination with other annotation curves, symbols, and text to depict information found on the drawing sheet;

– draughting dimension which specifies the resources necessary for the use of basic draughting elements, in combination with other annotation curves, symbols, and text, to depict dimensions, tolerances, and dimension-related information on a drawing sheet.

The objective of this part is the system-independent representation of digital CAD data resulting from the application of draughting practices in the drawing depiction of product definition data. This part provides for the representation of draughting information not provided for in other integrated resource parts of ISO 10303. Where necessary, it provides the draughting semantic extension to information represented in those parts.

Requirements and practices regarding the draughting-specific use, appearance, and specific aggregation of curves, symbols, and text are specified in draughting-practices standards regarding technical drawings, such as those compiled in ISO Standards Handbook 12.

Industrial automation systems and integration - Product data representation and exchange - Part 101: Integrated application resources: Draughting

1 Scope

This part of ISO 10303 specifies the resource constructs for the representation of draughting information. The following are within the scope of this part of ISO 10303:

– information regarding the definition, description, and administration of a drawing and the sheets of a drawing;

– elementary draughting annotations and their aggregation with more general annotations for the depiction of facts and requirements concerning the product or interpretation of a drawing;

– draughting annotations used in the depiction of dimensions, tolerances, and related dimension-measurement information.

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

– management information such as changes that create drawing versions, approvals, contracts under which draughting work is done, security classification, persons responsible, and the roles of responsibility of these persons, provided in ISO 10303-41;

– views and the viewing mechanism for depiction of the shape, provided in ISO 10303-46;

– styled generic annotations (i.e., curves, symbols, text and sectioning (crosshatching)), provided in ISO 10303-46;

– coordinate systems for the location of annotations, and their relationships, provided in ISO 10303-42 and ISO 10303-43.

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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 10209-1:1992, *Technical product documentation - Vocabulary - Part 1: Terms relating to technical drawings: general and types of drawing.*

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 10303-46:1994, *Industrial automation systems and integration - Product data representation and exchange - Part 46: Integrated generic resources: Visual presentation.*

ISO/IEC 8824-1:–[1)], *Information Technology - Open Systems Interconnection - Abstract Syntax Notation One (ASN.1) - Part 1: Specification of Basic Notation.*

3 Definitions

3.1 Terms defined in ISO 10303-1

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

– application;

– application protocol;

– application resource;

– data;

– formal;

– generic resource;

– information;

1) To be published.

– integrated resource;

– product;

– product data;

– resource construct.

3.2 Terms defined in ISO 10303-42

This part makes use of the following term defined in ISO 10303-42.

– curve.

3.3 Terms defined in ISO 10303-46

This part makes use of the following terms defined in ISO 10303-46.

– annotation;

– presentation.

3.4 Terms defined in ISO 10209-1

This part makes use of the following term defined in ISO 10209-1:

– drawing;

– technical drawing.

3.5 Other definitions

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

3.5.1 callout: A depiction of requirements and information about a product.

3.5.2 draughting; drafting: An activity of selecting and configuring appropriate representations of product data for the human-interpretable presentation in the form of a drawing.

3.5.3 drawing sheet: A subdivision of a drawing having the same identifier as the drawing and its own sheet number. A drawing sheet may contain part or all of the text or pictorial presentations of the drawing.

4 Drawing definition

The following EXPRESS declaration begins the **drawing_definition_schema** and identifies the necessary external references.

EXPRESS specification:

```
*)
SCHEMA drawing_definition_schema;

REFERENCE FROM support_resource_schema
    (label,
     text,
     identifier,
     bag_to_set);

REFERENCE FROM representation_schema
    (mapped_item,
     representation_relationship,
     representation);

REFERENCE FROM presentation_organization_schema
    (area_in_set,
     presentation_area,
     presentation_set,
     presentation_representation_relationship);
(*
```

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

support_resource_schema	ISO 10303-41
representation_schema	ISO 10303-43
presentation_organization_schema	ISO 10303-46

4.1 Introduction

The subject of the **drawing_definition_schema** is the identification, description, organization, and administration of drawing revisions. It identifies drawing revisions and drawing sheet revisions that comprise a drawing. It describes the relationship between revisions of drawings and sheets. In short, this schema provides resources for the definition and management of the drawing.

NOTE - An EXPRESS-G diagram for this schema appears in annex D.

4.2 Fundamental concepts and assumptions

A drawing is a draughting-specific presentation of information about a product including information used to interpret the presentation. A drawing can be partitioned or divided into a number of drawing sheets. Drawings are configured and administered by versions. Each drawing, including its drawing sheets, may have many versions. Versions of drawings and drawing sheets are known as revisions. A drawing is a revision whether it be initial or the result of change. If any drawing sheet is added, changed, or deleted, a new revision of the drawing may be established. The ability to identify and describe a drawing revision is provided, independently of organizational practices.

A revised drawing or drawing sheet is considered a successor of the original drawing or drawing sheet. The revisions of a drawing or drawing sheet may be sequentially ordered.

Drawing and drawing sheet revisions may have a draughting-specific title or description. A draughting title may change for subsequent revisions of the drawing or drawing sheet.

4.3 drawing_definition_schema type definition: draughting_titled_item

A selection of items which may be given a draughting-specific title.

EXPRESS specification:

```
*)
TYPE draughting_titled_item = SELECT
  (drawing_revision,
   drawing_sheet_revision);
END_TYPE;
(*
```

4.4 drawing_definition_schema entity definitions

4.4.1 drawing_definition

A drawing definition identifies and categorizes, by type, a set of drawing versions.

NOTE - When the need for a drawing is identified, a drawing definition begins its existence when the organization assigns a drawing number.

EXPRESS specification:

```
*)
ENTITY drawing_definition;
  drawing_number : identifier;
  drawing_type   : OPTIONAL label;
END_ENTITY;
(*
```

Attribute definitions:

drawing_number: An identifier for the versions of a drawing.

NOTE 1 - Drawing numbers themselves are often composed of parts such as: a type prefix, a part number (or stem), and a suffix. Its composition is provided by the originating organization.

EXAMPLE 1 - "CK123456-789", "DL-S12345", "1B5102-04", and "1D55500" are examples of drawing number strings.

drawing_type: A label used to describe the functional categorization of the drawing.

NOTE 2 - A type of drawing is used to communicate a specific portion of the information about a product. For a printed wiring assembly, the functional aspects are communicated by means of a schematic diagram whereas the physical aspects are communicated by means of another drawing type.

EXAMPLE 2 - "SCHEMATIC DIAGRAM", "SITE PLAN", "DETAIL", and "ASSEMBLY" are examples of drawing-type labels. Additional examples for drawing-type labels may be found in clause 3 of ISO 10209-1.

4.4.2 drawing_revision

A drawing revision is a version of a drawing, resulting from creation or change.

EXPRESS specification:

```
*)
ENTITY drawing_revision
  SUBTYPE OF (presentation_set);
  revision_identifier : identifier;
  drawing_identifier  : drawing_definition;
  intended_scale      : OPTIONAL text;
UNIQUE
  UR1: revision_identifier, drawing_identifier;
END_ENTITY;
(*
```

Attribute definitions:

revision_identifier: An identifier for the revision of the drawing.

NOTE - The values for this representation may be comprised of any allowable characters. Any limit or restrictions must be specified in an Application Protocol. Typically the revision identifier is an alphanumeric string.

EXAMPLE 3 - The revision identifier may be "A", "AA", "2.4", or could be "31".

drawing_identifier: An identifier for the drawing.

intended_scale: A text description of the intended drawing scale where the description is for information only.

EXAMPLE 4 - "1/4", "100:1", "NONE" are drawing scale examples.

Formal propositions:

UR1: The identifier for a version of a drawing shall be unique for that drawing.

EXAMPLE 5 - A drawing revision identified by the letter "A" is the only drawing revision identified by that letter in the set of revisions of a particular drawing.

4.4.3 drawing_revision_sequence

A drawing revision sequence is the successive relationship of one version to another for the same drawing.

EXAMPLE 6 - If two drawing revisions were identified by revision identifiers equal to A and B successively, the drawing revision identified by A would play the role of predecessor and the drawing revision identified by B would play the role of successor in the sequence of drawing revisions.

EXPRESS specification:

```
*)
ENTITY drawing_revision_sequence;
  predecessor : drawing_revision;
  successor   : drawing_revision;
WHERE
  WR1: predecessor :<>: successor;
END_ENTITY;
(*
```

Attribute definitions:

predecessor: A version of a drawing which precedes another version of a drawing.

successor: A version of a drawing which succeeds another version of a drawing.

NOTE - A drawing version (i.e., drawing_revision) may precede or succeed another version of the same drawing or a version of a different drawing (i.e., not identified by the same drawing_definition) in a logical sequence of drawings .

Formal propositions:

WR1: A particular revision of a drawing shall not precede nor succeed itself.

4.4.4 drawing_sheet_revision

A drawing sheet revision is a version of a drawing sheet. It may either be an initial version or a modification of a previous version.

NOTE 1 - As a type of **area_in_set**, the **drawing_sheet_revision** provides the information necessary to present a version of a drawing sheet. It also specifies the administrative data used to manage a version of a drawing sheet, with respect to the drawing revision.

EXPRESS specification:

```
*)
ENTITY drawing_sheet_revision
  SUBTYPE OF (presentation_area);
  revision_identifier : identifier;
WHERE
  WR1: SIZEOF( QUERY(item <* SELF\representation.items |
       ('REPRESENTATION_SCHEMA.MAPPED_ITEM' IN (TYPEOF(item)))
       AND
       ('DRAWING_DEFINITION_SCHEMA.DRAWING_SHEET_REVISION' IN
       (TYPEOF(item\mapped_item.mapping_source.mapped_representation)))))=0;
END_ENTITY;
(*
```

Attribute definitions:

revision_identifier: Identifier for the revision of a drawing sheet.

Formal propositions:

WR1: A **drawing_sheet_revision** shall not have another **drawing_sheet_revision** mapped into it.

NOTE 2 - For requirements regarding the **mapped_item** see of ISO 10303-43.

4.4.5 drawing_sheet_revision_sequence

A drawing sheet revision sequence is an association between two drawing sheet revisions that specifies one as the successor of the other.

EXAMPLE 7 - An instance of **drawing_sheet_revision_sequence** where **rep_1** is an instance of **drawing_sheet_revision** with a **revision_identifier** of "A" and **rep_2** is an instance of **drawing_sheet_revision** with a **revision_identifier** of "B" represents the successive relationship between the predecessor (revision "A") and successor (revision "B").

EXPRESS specification:

```
*)
ENTITY drawing_sheet_revision_sequence
  SUBTYPE OF (representation_relationship);
WHERE
  WR1: SELF\representation_relationship.rep_1 :<>:
       SELF\representation_relationship.rep_2;
  WR2: 'DRAWING_DEFINITION_SCHEMA.DRAWING_SHEET_REVISION'
       IN TYPEOF (SELF\representation_relationship.rep_1);
  WR3: 'DRAWING_DEFINITION_SCHEMA.DRAWING_SHEET_REVISION'
       IN TYPEOF (SELF\representation_relationship.rep_2);
END_ENTITY;
(*
```

Attribute definitions:

SELF\representation_relationship.rep_1: The **drawing_sheet_revision** that is the predecessor in the **drawing_sheet_revision_sequence**.

SELF\representation_relationship.rep_2: The **drawing_sheet_revision** that is the successor in the **drawing_sheet_revision_sequence**.

Formal propositions:

WR1: The **drawing_sheet_revisions** that are related shall be different instances.

WR2: rep_1 shall be a **drawing_sheet_revision**.

WR3: rep_2 shall be a **drawing_sheet_revision**.

4.4.6 drawing_sheet_revision_usage

The **drawing_sheet_revision_usage** entity relates a **drawing_sheet_revision** with a **drawing_revision** and assigns a sheet number for this usage, where a **drawing_sheet_revision** may be used in more than one **drawing_revision**.

EXPRESS specification:

```
*)
ENTITY drawing_sheet_revision_usage
  SUBTYPE OF (area_in_set);
  sheet_number : identifier;
UNIQUE
  UR1: sheet_number, in_set;
WHERE
  WR1: 'DRAWING_DEFINITION_SCHEMA.DRAWING_SHEET_REVISION' IN TYPEOF
       (SELF\area_in_set.area)AND'DRAWING_DEFINITION_SCHEMA.DRAWING_REVISION'
      IN TYPEOF (SELF\area_in_set.in_set);
END_ENTITY;
(*
```

Attribute definitions:

sheet_number: An identifier indicating the position of a drawing sheet in a sequence of drawing sheets which are part of a drawing.

NOTE - Drawing sheets are not restricted to being numbered contiguously. Sheet numbering is business practice specific.

EXAMPLE 8 - Sheets numbered 1,2,4,5... where sheet 3 has been deleted is an example of a valid set of drawing sheet numbers for a drawing revision.

SELF\area_in_set.area: The drawing sheet revision being used in a set of drawing sheet revisions for a particular drawing revision.

SELF\area_in_set.in_set: The drawing revision in which a particular drawing sheet revision is used.

Formal propositions:

UR1: No **drawing_revision** shall have two **drawing_sheet_revisions** identified by the same sheet number.

WR1: Only **drawing_sheet_revisions** shall be used as a numbered sheet of a **drawing_revision** and only **drawing_revisions** shall use **drawing_ sheet_revisions** as a numbered sheet.

4.4.7 draughting_title

A draughting title is brief text describing the contents of the drawing or drawing sheet. It is draughting application-specific, language-dependent, and may be applicable to more than one drawing or drawing sheet.

EXAMPLE 9 - A drawing containing the mechanical compatibility information for a safety switching device may be given a text description such as "MECHANICAL COMPATIBILITY, SAFETY SWITCH", where the language is English.

EXPRESS specification:

```
*)
ENTITY draughting_title;
  items    : SET [1:?] OF draughting_titled_item;
  language : label;
  contents : text;
END_ENTITY;
(*
```

Attribute definitions:

items: The drawing sheets or revisions to which the title applies.

language: A label indicating the language used for terms in the contents of the **draughting_title**.

NOTE - The language label should be comprised of characters indicating the name of the language, such as those specified in table 1 of ISO 639:1988.

contents: The text of the title.

EXAMPLE 10 - "BRACKET - CABLE, ASSY OF" and "DISK - LPC, 4 STG" are examples of titles.

4.5 drawing_definition_schema rule definition: drawing_sheets_not_nested

This rule ensures that a **drawing_sheet_revision** shall not be related to another **drawing_sheet_revision** by transformation.

EXPRESS Specification:

```
*)
RULE drawing_sheets_not_nested FOR (presentation_representation_relationship);
WHERE
  WR1: SIZEOF( QUERY(p_r_r <* presentation_representation_relationship |
         ('DRAWING_DEFINITION_SCHEMA.DRAWING_SHEET_REVISION'
        IN (TYPEOF(p_r_r.rep_1))) AND
        ('DRAWING_DEFINITION_SCHEMA.DRAWING_SHEET_REVISION'
        IN (TYPEOF( p_r_r.rep_2))))) = 0;
END_RULE;
(*
```

Formal propositions:

WR1: A **drawing_sheet_revision** shall not play the role of parent representation in a **presentation_representation_relationship** where the child representation is also a **drawing_sheet_revision**.

NOTE - For requirements regarding the **presentation_representation_relationship**, see ISO 10303-46.

```
*)
END_SCHEMA; -- drawing_definition_schema
(*
```

5 Draughting element

The following EXPRESS declaration begins the **draughting_element_schema** and identifies the necessary external references.

EXPRESS Specification:

```
*)
SCHEMA draughting_element_schema;

REFERENCE FROM geometry_schema (geometric_representation_item);

REFERENCE FROM support_resource_schema
    (label,
     text);

REFERENCE FROM presentation_definition_schema
    (annotation_occurrence,
     annotation_curve_occurrence,
     annotation_text_occurrence,
     annotation_symbol_occurrence);
(*
```

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

geometry_schema	ISO 10303-42
support_resource_schema	ISO 10303-41
presentation_definition_schema	ISO 10303-46

5.1 Introduction

The subjects of the **draughting_element_schema** are the basic draughting elements used on drawings to convey information about the product being depicted. Text using draughting-specific fonts and character sets is used to convey product and product-processing requirements and to make references to other requirements documents. Curves with draughting-specific thicknesses (widths) and dash patterns are used to clarify the depiction of a product shape. Images of the shape are annotated with curves representing feature centres, path of motion, and location of cutting planes. The draughting activity also uses many symbols to convey requirements for characteristics such as surface texture and welds. These draughting curves, text, and symbols are often combined to form a complete presentation of a requirement and are referred to as a draughting callout.

Draughting often applies a requirement to a specific area of the depicted product shape. In such instances other draughting curves, such as leader lines, projection lines, and dimension lines, are used to direct the requirement to the place of application.

This schema specifies the basic draughting elements and their combinations used to annotate the depicted product shape and convey information regarding interpretation of the drawing.

NOTE - EXPRESS-G diagrams for this schema appear in annex D.

5.2 Fundamental concepts and assumptions

The draughting activity, regardless of the engineering discipline, specializes generic annotation curves, symbols, and text. The specialization of annotation curves is based on the need to identify certain curves according to existing draughting standards. Further, the specialization makes it possible to assign curve presentation styles according to those same standards. The specialization of generic annotation text is based on the draughting need to specify draughting-specific fonts and character sets. The specialization of generic annotation symbols is based on the need for draughting symbols to be comprised of draughting-specific curves and text.

The three most common draughting-specific annotation curves are the dimension line, leader line, and projection line (also known as an extension line or witness line). These draughting annotation curves are not limited to their stated geometric type. A leader line referring to a feature on a drawing, such as a dimension, object, or outline, is really a series of one-to-many curve segments, not necessarily line segments. This fact is also true of the projection line and dimension line.

Dimension lines, leader lines, and projection lines can be shared by more than one callout.

EXAMPLE 11 - A single instance of a leader line can be used to direct (refer) a callout, containing a dimension value and tolerance, while also directing a second callout, containing a geometric tolerance of location, to the same feature of size (see Figure 1).

Dimension lines and leader lines cannot exist independently of a callout. Only the projection line can exist independently (without directing a callout).

A callout directed by means of both a leader line and a projection line is both a leader-directed callout and a projection-directed callout.

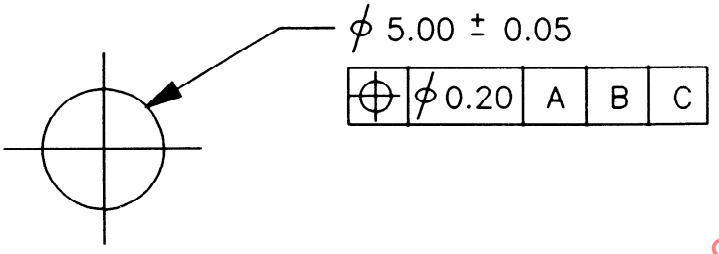

Figure 1 - Leader line shared by dimension and tolerance

A terminator symbol (e.g., arrowhead) is another concept of existing draughting-practices standards. A terminator symbol may be used to terminate a leader line, or it may be used to show the extent of the dimension and the direction of measurement when placed along a dimension line. Although referred to as an arrow or arrowhead, some draughting practices standards specify other symbols, such as a dot, box, or slash to terminate a leader line or indicate a dimension extent. Therefore, this concept has been generalized as a terminator symbol.

A draughting callout is a collection of draughting- or presentation-specific annotation curves, text, and symbols depicting information or requirements about the product or drawing itself. This part of ISO 10303 supports callouts which may contain text, symbols, or curves that are directed to a feature (a place on a drawing) by a leader line, a projection line, a dimension line, or a combination of these. A callout whose text, symbols, or curves are directed by means of both a leader line and a projection line is both a leader-directed callout and a projection callout.

Draughting Application Protocols may further specialize resources found in this schema or in ISO 10303-46 to obtain draughting concepts not explicitly provided.

5.3 draughting_element_schema type definitions

5.3.1 draughting_callout_element

A draughting callout element is either draughting text, symbols, or curves which are a part of a draughting callout.

EXPRESS specification:

```
*)
TYPE draughting_callout_element = SELECT
  (annotation_text_occurrence,
   annotation_symbol_occurrence,
   annotation_curve_occurrence);
END_TYPE;
(*
```

5.3.2 dimension_extent_usage

The dimension extent usage establishes the logical location of terminator symbols on the dimension line. The logical location is defined by an origin and a target.

EXPRESS specification:

```
*)
TYPE dimension_extent_usage = ENUMERATION OF
  (origin,
   target);
END_TYPE;
(*
```

Enumerated item definitions:

origin: The beginning of the dimension.

target: The end of the dimension.

5.4 draughting_element_schema entity definitions

5.4.1 dimension_curve

A dimension curve is a draughting annotation curve with a draughting-specific appearance that, with related terminator symbols, presents the direction and extent of a measurement. The dimension curve is also used to direct the presentation of dimension-related information to the presentation of the applicable feature or features.

A **dimension_curve** is used in a **dimension_curve_directed_callout** to direct the other elements of the callout to the presentation of the dimensioned feature or features.

NOTE 1 - Various forms of the dimension curve, also known as a dimension line, with their related terminator symbols are shown in Figure 2. Dimension curves are combined with other draughting annotation

curves (e.g., extension lines), text, and symbols to form **dimension_curve_directed_callouts** and **dimension_graphs** according to 5.4.11 and 6.3.2.

Figure 2 - Dimension curves

NOTE 2 - Although the dimension curve is generally thin and continuous in nature, it may be broken for the insertion of the dimension text and symbols, making the dimension curve appear as two leader lines. A break in the dimension curve is possible through use of resources provided by ISO 10303-46.

EXPRESS specification:

```
*)
ENTITY dimension_curve
  SUBTYPE OF (annotation_curve_occurrence);
WHERE
  WR1: SIZEOF( USEDIN( SELF, 'DRAUGHTING_ELEMENT_SCHEMA.'+
       'DIMENSION_CURVE_TERMINATOR.ANNOTATED_DIMENSION_'+
       'CURVE')) <= 2;
  WR2: SIZEOF(USEDIN(SELF,'DRAUGHTING_ELEMENT_SCHEMA.'+
       'DIMENSION_CURVE_DIRECTED_CALLOUT.CONTENTS')) >= 1;
  WR3: (SIZEOF(QUERY(dct_1 <* USEDIN(SELF,'DRAUGHTING_ELEMENT_'+
       'SCHEMA.DIMENSION_CURVE_TERMINATOR.ANNOTATED_DIMENSION_'+
       'CURVE') | (dct_1.role = origin))) <=1) AND
       (SIZEOF(QUERY(dct_2 <* USEDIN(SELF,'DRAUGHTING_ELEMENT_'+
       'SCHEMA.DIMENSION_CURVE_TERMINATOR.ANNOTATED_DIMENSION_'+
       'CURVE') | (dct_2.role = target))) <=1);
END_ENTITY;
(*
```

Formal propositions:

WR1: There may be zero, one, or two **terminator_symbols** annotating a dimension curve.

WR2: A **dimension-curve** shall be used by at least one referencing **dimension_curve_directed_callout**.

NOTE 3 - A **dimension_curve** is used to direct information to the dimensioned feature or features. Curves which do not meet this requirement should be treated as annotation curves with referencing terminator symbols.

WR3: A dimension curve shall not be annotated with more than one terminator symbol indicating the origin of a dimension extent, nor shall a dimension curve be annotated with more than one terminator symbol indicating the target of a dimension extent.

5.4.2 leader_curve

A leader curve is a draughting annotation curve which directs the eye of the reader from presented requirements or information to an intended place on the drawing. A leader curve itself may be annotated with a terminator symbol, such as an arrow, to indicate the point of interest.

A **leader_curve** is used in a **leader_directed_callout** to direct the other elements of the callout to an intended place or point of interest on a drawing.

NOTE 1 - Generally, a leader curve, also known as a leader line, is a continuous thin single or multiple segment curve with a terminator symbol at one end, indicating the place of interest. Various forms of the leader curve are shown in Figure 3. Style requirements are specified in other international and national draughting practices standards.

Figure 3 - Leader curves

EXPRESS specification:

```
*)
ENTITY leader_curve
  SUBTYPE OF (annotation_curve_occurrence);
WHERE
  WR1: SIZEOF( USEDIN( SELF, 'DRAUGHTING_ELEMENT_SCHEMA.'+
    'LEADER_DIRECTED_CALLOUT.CONTENTS')) >= 1;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **leader_curve** shall be used by at least one referencing **leader_directed_callout**.

NOTE 2 - A **leader_curve** always directs other information contained within a **draughting_callout** to a place on a drawing. Curves which do not meet this requirement should be treated as annotation curves with a referencing terminator symbol.

5.4.3 projection_curve

A projection curve is a draughting annotation curve which is the result of projecting a point, curve, or surface from an image of the product shape, to a point outside that image.

NOTE 1 - A projection curve, also known as projection line, extension line, or witness line, generally has a presentation style which is thin and continuous. To accommodate various draughting practices, no restriction on presentation style has been made.provides an example of the use of two projection curves.

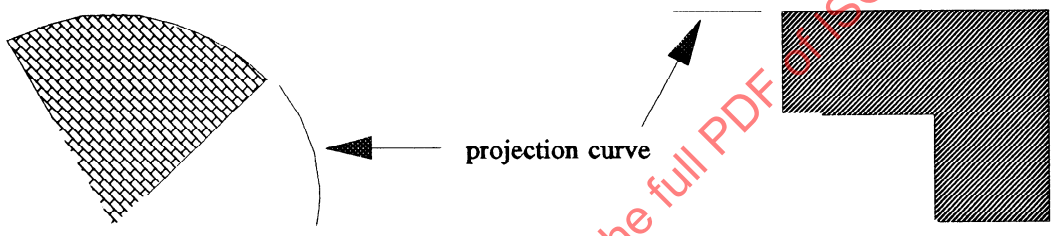

Figure 4 - Projection curves

NOTE 2 - Figure 4 provides two examples of projection curves. Both projection curves extend a surface to locations beyond the outline of the depicted part. A projection curve may be combined with other curves, text, and symbols to form a **projection_directed_callout** according to 5.4.10.

NOTE 3 - Although a projection curve is generally not presented as a dashed pattern, it may have an invisible segment where it crosses an arrowhead. This characteristic is made possible through the use of resources provided by ISO 10303-46.

EXPRESS specification:

```
*)
ENTITY projection_curve
  SUBTYPE OF (annotation_curve_occurrence);
END_ENTITY;
(*
```

5.4.4 terminator_symbol

A terminator symbol is a styled annotation which indicates the termination of a curve or the measurement-extent and direction of a dimension.

NOTE - A terminator symbol such as an arrow, may also be used to indicate a direction of interest (e.g., measuring direction of a dimension line or viewing direction for a line indicating the cutting plane of a section view).

EXPRESS specification:

```
*)
ENTITY terminator_symbol
  SUBTYPE OF (annotation_symbol_occurrence);
  annotated_curve : annotation_curve_occurrence;
END_ENTITY;
(*
```

Attribute definitions:

annotated_curve: The curve being annotated by the terminator symbol.

5.4.5 dimension_curve_terminator

A dimension curve terminator is a symbol representing the start or terminus of a dimension extent. When an arrow is used for the dimension curve terminator, it also indicates the measuring direction of a dimension.

EXPRESS specification:

```
*)
ENTITY dimension_curve_terminator
  SUBTYPE OF (terminator_symbol);
  role  : dimension_extent_usage;
WHERE
  WR1: 'DRAUGHTING_ELEMENT_SCHEMA.DIMENSION_CURVE' IN TYPEOF
       (SELF\terminator_symbol.annotated_curve);
END_ENTITY;
(*
```

Attribute definitions:

role: The role of the **dimension_curve_terminator** as a dimension **origin** or **target** in the presentation of the dimension extent being graphed.

NOTE - A **dimension_curve_terminator** in the role of **origin** is located with respect to a point on the dimension line, generally corresponding to the beginning or start of a dimension. A **dimension_curve_terminator** in the role of **target** is located with respect to a point on the dimension line, generally corresponding to the end of a dimension. Where a **dimension_curve_terminator** is to correspond with the **dimension_graph_projection_curve_usage**, the same role should be assigned to both with respect to the extent of the **dimension_graph**.

Formal propositions:

WR1: Each **dimension_curve_terminator** shall annotate a **dimension_curve**.

5.4.6 leader_terminator

A leader terminator is a symbol indicating the place of interest on a drawing. A leader terminator located at the target end of a leader line is used to direct the reader's eye to the place of interest.

EXPRESS specification:

```
*)
ENTITY leader_terminator
  SUBTYPE OF (terminator_symbol);
WHERE
  WR1: 'DRAUGHTING_ELEMENT_SCHEMA.LEADER_CURVE' IN TYPEOF
       (SELF\terminator_symbol.annotated_curve);
END_ENTITY;
(*
```

Formal propositions:

WR1: A **leader_terminator** shall annotate a **leader_curve**.

5.4.7 draughting_callout

A draughting callout is a human-interpretable collection of annotation curves, symbols, and text that presents product requirements or information used to interpret the drawing.

A draughting callout is classified by the type of curve that directs information within the draughting callout or by its contents that present product requirements such as dimension measurements.

A draughting callout may contain text, symbols, and curves which are directed to a place of interest on the drawing by means of a leader line, projection line, dimension line, or a combination of these. A draughting callout that includes a leader line to direct the eye of the reader to a place of interest is a leader directed callout. Requirements for a **leader_directed_callout** are specified in 5.4.9. A draughting callout that includes a projection line to direct the eye of the reader to a place of interest is a projection directed callout. Requirements for a **projection_directed_callout** are specified in 5.4.10. A draughting callout that includes a dimension line to direct information in the callout is a dimension curve directed callout. Requirements for a **dimension_curve_directed_callout** are specified in 5.4.11.

If the draughting callout is to present a product requirement about a known dimension measurement, it is a dimension callout. Requirements for a **dimension_callout** are specified in 6.3.1.

EXPRESS specification:

```
*)
ENTITY draughting_callout
  SUBTYPE OF (geometric_representation_item);
  contents : SET [1:?] OF draughting_callout_element;
END_ENTITY;
(*
```

Attribute definitions:

contents: The annotation curves, symbols, or text comprising the presentation of information.

5.4.8 draughting_callout_relationship

A draughting callout relationship is a logical relationship between two annotation groups which appear on a drawing. Such relationships are often implied by the creator of a drawing by placing a group of annotations in the proximity of another group of annotations. See examples 13 and 14 below.

NOTE 1 - This entity, in conjunction with the **draughting_callout** entity, is based on the relationship template that is described in annex D of ISO 10303-41.

EXPRESS specification:

```
*)
ENTITY draughting_callout_relationship;
  name : label;
  description : text;
  relating_draughting_callout : draughting_callout;
  related_draughting_callout : draughting_callout;
END_ENTITY;
(*
```

Attribute definitions:

name: the word or group of words by which the **draughting_callout_relationship** is spoken of or referred to.

description: text that relates the nature of the **draughting_callout_relationship**.

relating_draughting_callout: one of the **draughting_callouts** which is a part of the relationship.

EXAMPLE 13 - If the **drafting_callout_relationship** is a relationship between a leader directed dimension and a geometric tolerance frame (see Figure 1), the relating **draughting_callout** may be the leader directed dimension for a feature of size.

NOTE 2 - The role of this attribute is defined in the application protocol or the ISO 10303 integrated resource that uses or specializes this entity.

related_draughting_callout: the other **draughting_callout** which is a part of the relationship.

EXAMPLE 14 - In a leader directed dimension with a related geometric tolerance frame (see Figure 1) the related draughting callout may be the geometric tolerance frame, where the geometric tolerance frame is being referred to the feature of size via the leader directed dimension.

NOTE 3 - The role of this attribute is defined in the application protocol or the ISO 10303 integrated resource that uses or specializes this entity.

5.4.9 leader_directed_callout

A leader directed callout is a draughting callout which includes one or more leader lines to direct the eye of the reader from the other presented requirements and information to a place or places of interest on the drawing.

NOTE - An example of a leader directed callout is given in Figure 5.

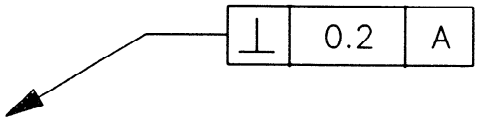

Figure 5 - Leader directed callout

EXPRESS specification:

```
*)
ENTITY leader_directed_callout
  SUBTYPE OF (draughting_callout);
WHERE
  WR1: SIZEOF (QUERY (l_1 <* SELF\draughting_callout.contents |
       'DRAUGHTING_ELEMENT_SCHEMA.LEADER_CURVE' IN (TYPEOF(l_1)))) >= 1;
  WR2: SIZEOF(SELF\draughting_callout.contents) >=2;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **leader_directed_callout** shall have at least one **leader_curve** in the set of **draughting_callout_elements**.

WR2: A **leader_directed_callout** shall contain some annotation other than the required **leader_curve**.

5.4.10 projection_directed_callout

A projection directed callout is a draughting callout which includes a projection line to direct the eye of the reader from the other presented requirements and information to the projected element of the product shape.

NOTE - An example of a projection directed callout is shown in Figure 6. In this figure a callout, representing a surface tolerance requirement, is directed to the surface by a projection curve, representing an extension of the surface.

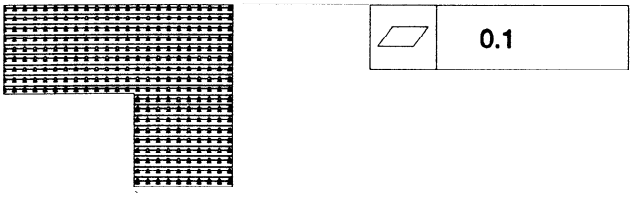

Figure 6 - Projection directed callout

EXPRESS specification:

```
*)
ENTITY projection_directed_callout
  SUBTYPE OF (draughting_callout);
WHERE
  WR1: SIZEOF(QUERY(p_1<*SELF\draughting_callout.contents |
       'DRAUGHTING_ELEMENT_SCHEMA.PROJECTION_CURVE' IN (TYPEOF(p_1))))=1;
  WR2: SIZEOF(SELF\draughting_callout.contents) >=2;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **projection_directed_callout** shall have exactly one **projection_curve** in the set of **draughting_callout_elements**.

WR2: A **projection_directed_callout** shall contain some annotation other than the required **projection_curve**.

5.4.11 dimension_curve_directed_callout

A dimension curve directed callout is a draughting callout directed by a dimension line to a presented element of the product shape.

NOTE 1 - A draughting callout for a geometric tolerance may be directed to the presentation of the toleranced feature by means of a dimension line. An example of a dimension curve directed callout is shown in Figure 7.

NOTE 2 - Generally, a **dimension_curve** for a **dimension_curve_directed_callout** is also the **dimension_curve** for a **dimension_graph** (**draughting_dimension_schema**, see 6.3.2).

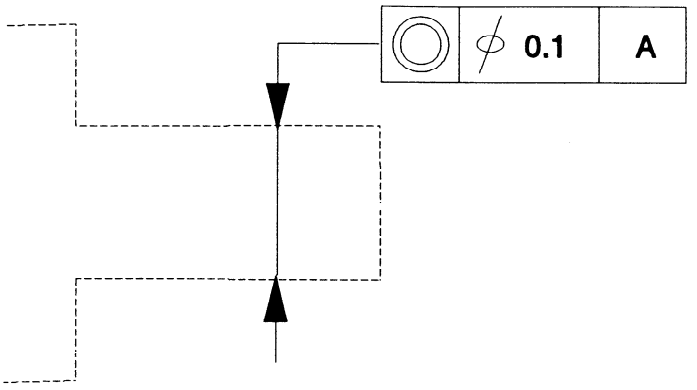

Figure 7 - Dimension curve directed callout

EXPRESS specification:

```
*)
ENTITY dimension_curve_directed_callout
  SUBTYPE OF (draughting_callout);
WHERE
  WR1: SIZEOF(QUERY(d_c<*SELF\draughting_callout.contents |
       'DRAUGHTING_ELEMENT_SCHEMA.DIMENSION_CURVE' IN (TYPEOF(d_c))))=1;
  WR2: SIZEOF(SELF\draughting_callout.contents) >= 2;
END_ENTITY;
(*
```

Formal propositions:

WR1: A **dimension_curve_directed_callout** shall have exactly one **dimension_curve** in the set of **draughting_callout_elements**.

WR2: A **dimension_curve_directed_callout** shall contain some annotation other than the required **dimension_curve**.

```
*)
END_SCHEMA; -- draughting_element_schema
(*
```


6 Draughting dimension

The following EXPRESS declaration begins the **draughting_dimension_schema** and identifies the necessary external references.

EXPRESS specification:

```
*)
SCHEMA draughting_dimension_schema;

REFERENCE FROM draughting_element_schema
    (dimension_curve,
     leader_curve,
     projection_curve,
     draughting_callout,
     draughting_callout_relationship,
     dimension_curve_directed_callout,
     leader_directed_callout,
     projection_directed_callout,
     dimension_extent_usage);
(*
```

NOTE - The schema referenced above can be found in the following part of ISO 10303:

draughting_element_schema Clause 5 of this part of ISO 10303

6.1 Introduction

The subject of the **draughting_dimension_schema** is the dimension-related information. Through use of this schema it is possible to identify a collection of annotation curves, symbols, and text as those which present information about a dimension value and its unit of measure. This includes those collections which graphically depict the extent and direction of measure. It is also possible to maintain relationships, such as a common datum or baseline, between dimension presentations.

NOTE - EXPRESS-G diagrams for this schema appear in annex D.

6.2 Fundamental concepts and assumptions

The draughting presentation of dimensions and their related information is accomplished using specialized combinations of draughting elements, such as annotation curves, text, and symbols. The combinations of annotation curves, text, and symbols used for presenting dimension information, are the same combinations used elsewhere in draughting, except that the information being presented is that of a dimension..

The presentation of dimension information may be independent of or directed to the draughting presentation of the feature being dimensioned by such draughting elements as leader lines, projection lines, or dimension lines.

Dimension lines direct information about the dimension size or location and depict graphically the extent of the dimension and the direction of measurement.

A dimension graph is a combination of draughting elements that incorporate a dimension line, depicting the extent and direction of a dimension measurement.

Dimension graphs may be successively positioned in a sequence. If so, they may share projection lines.

The type of the dimension graph does not always match the nature of the dimension being presented. An angular dimension graph always presents an angular dimension, but a diameter dimension may be presented by a linear form of the dimension graph as well as by the diameter form of the dimension graph.

NOTE - Figure 8 gives examples of two forms of the dimension graph; both graphically present the same diameter dimension.

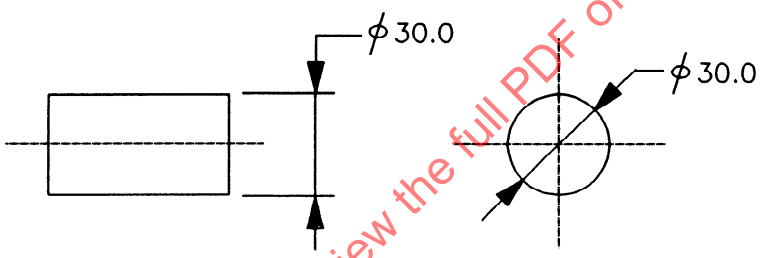

Figure 8 - Dimension graphs

Draughting Application Protocols may further specialize resources found in this schema or in ISO 10303-46 to obtain draughting concepts not explicitly provided.

6.3 draughting_dimension_schema entity definitions

6.3.1 dimension_callout

A dimension callout is a grouping of annotations positioned in a drawing and used to present information about a required measurement governing the size and shape of an object, also being presented on a drawing. Measurement information is represented by text and symbols and is referred to a place on the presented object. Measurement information may be referred to a place on the object by a leader, a projection, or a dimension line, or a combination of the three. Alternatively, measurement information may be placed in the context of a table and referred by other means.

When the information about a measurement is referred to a place on the drawing by means of a leader line or projection line, the **dimension_callout** shall also be a **leader_curve_directed_callout** (see 5.4.9) or a **projection_directed_callout** (see 5.4.10).

When the extent and direction of a measurement are represented by a dimension line or curve, the **dimension_callout** shall also be a **dimension_curve_directed_callout** (see 5.4.11).

When a **dimension_callout**, which is dimension curve directed, is to participate in chain or parallel dimension sequence, it shall also be a **dimension_graph** as required by 6.3.2.

EXPRESS specification:

```
*)
ENTITY dimension_callout
  SUBTYPE OF (draughting_callout);
WHERE
  WR1: ('DRAUGHTING_ELEMENT_SCHEMA.LEADER_DIRECTED_CALLOUT'
        IN (TYPEOF (SELF))) XOR
       (SIZEOF (QUERY(dce_1 <* SELF\draughting_callout.contents |
       ('DRAUGHTING_ELEMENT_SCHEMA.LEADER_CURVE'
        IN (TYPEOF(dce_1))))) = 0);
  WR2: ('DRAUGHTING_ELEMENT_SCHEMA.PROJECTION_DIRECTED_CALLOUT'
        IN (TYPEOF (SELF))) XOR
       (SIZEOF (QUERY(dce_1 <* SELF\draughting_callout.contents |
       ('DRAUGHTING_ELEMENT_SCHEMA.PROJECTION_CURVE'
        IN (TYPEOF(dce_1))))) = 0);
  WR3: ('DRAUGHTING_ELEMENT_SCHEMA.DIMENSION_CURVE_DIRECTED_CALLOUT'
        IN (TYPEOF (SELF)))) XOR
       (SIZEOF (QUERY(dce_1 <* SELF\draughting_callout.contents |
       ('DRAUGHTING_ELEMENT_SCHEMA.DIMENSION_CURVE'
        IN (TYPEOF(dce_1))))) = 0);
END_ENTITY;
(*
```

Formal propositions:

WR1: A **dimension_callout** shall be a **leader_directed_callout**, else the **dimension_callout** shall contain no **leader_curves**.

NOTE 1 - For further constraints regarding the **leader_curve**, as it applies to the **leader_directed_callout**, see 5.4.9.

WR2: A **dimension_callout** shall be a **projection_directed_callout**, else the **dimension_callout** shall contain no **projection_curves**.

NOTE 2 - For further constraints regarding the **projection_curve**, as it applies to the **projection_directed_callout**, see 5.4.10.

WR3: A dimension_callout shall be a **dimension_curve_directed_callout**, else the **dimension_callout** shall contain no **dimension_curves**.

NOTE 3 - For further constraints regarding the **dimension_curve**, as it applies to the **dimension_curve_directed_callout**, see 5.4.11.

6.3.2 dimension_graph

A dimension graph is a dimension callout where the extent and direction of the required measurement is also being presented. In a dimension graph, the extent of the measurement is presented by means of a dimension line or curve. Therefore, the **dimension_graph** shall also be a **dimension_curve_directed_callout** (see 5.4.11).

A dimension graph may be positioned on the drawing in a chain or parallel sequence of one or more dimension graphs. Such sequences of dimension graphs shall be maintained by using the **dimension_graph_sequence** entity (as defined in 6.3.4).

Projection lines, used to relate the dimension line or curve to a place or places on a drawing are shared between sequenced dimension graphs. Where a dimension graph either participates or may later participate in a chain or parallel sequence, projection lines shall be related to the dimension graph by using the **dimension_graph_projection_curve_usage** entity (as defined in 6.3.3).

NOTE - This provides a generalized **dimension_graph**. It may be necessary to use an Application Protocol to further specialize this entity to identify allowable forms such as angular, curve, diameter, linear, radius, etc.

EXPRESS specification:

```
*)
ENTITY dimension_graph
  SUBTYPE OF (dimension_curve_directed_callout);
WHERE
  WR1: SIZEOF(USEDIN(SELF,'DRAUGHTING_DIMENSION_SCHEMA.'+
       'DIMENSION_GRAPH_PROJECTION_CURVE_USAGE.GRAPH')) <= 2;
  WR2: SIZEOF(QUERY(dce <* SELF\draughting_callout.contents |
       'DRAUGHTING_ELEMENT_SCHEMA.PROJECTION_CURVE'
       IN (TYPEOF(dce)))) = 0;
  WR3: 'DRAUGHTING_DIMENSION_SCHEMA.DIMENSION_CALLOUT'
       IN (TYPEOF(SELF));
END_ENTITY;
(*
```

Formal propositions:

WR1: A **dimension_graph** shall be combined with at most two projection lines.

WR2: A **dimension_graph** shall only have projection lines provided by the **dimension_graph_projection_curve_usage**.

WR3: A **dimension_graph** is both a **dimension_curve_directed_callout** and a **dimension_callout**.

6.3.3 dimension_graph_projection_curve_usage

The **dimension_graph_projection_curve_usage** is the relationship of a projection curve to a dimension graph, where the projection curve may participate in a similar relationship with one or more dimension graphs. For each relationship, a projection curve may play the same or a different role with respect to a particular dimension graph.

NOTE 1 - A **projection_curve** may be used by more than one dimension graph. When a **projection_curve** is shared, it may or may not play the same role with respect to both **dimension_graph**s.

EXPRESS specification:

```
*)
ENTITY dimension_graph_projection_curve_usage;
  graph           : dimension_graph;
  projection_line : projection_curve;
  role            : dimension_extent_usage;
UNIQUE
  UR1: graph, projection_line;
  UR2: graph, role;
END_ENTITY;
(*
```

Attribute definitions:

graph: The **dimension_graph** that uses the projection line.

projection_line: The **projection_curve** used by the **dimension_graph**.

role: The role of the **projection_curve** in the **dimension_graph**.

NOTE 2 - The role of the **projection_curve** in the **dimension_graph** is either the origin or the target, corresponding to an extent of the dimension being depicted graphically. Where a dimension graph projection curve usage is to correspond with the dimension curve terminator, the same role should be assigned to both with respect to the extent of the dimension graph.

Formal proposition:

UR1: The combination of graph and projection line shall be unique.

UR2: The role of the projection line in the dimension graph shall be unique.

6.3.4 dimension_graph_sequence

A dimension graph sequence is the ordered relationship between two dimension graphs, making it possible to present the relationship between two dimensions.

NOTE - ISO 129 describes both parallel (baseline) and chain dimensioning. The relationship between dimension graphs presenting information about two successive dimensions (either parallel or chain) can be maintained using specializations of this entity.

EXPRESS specification:

```
*)
ENTITY dimension_graph_sequence
  SUBTYPE OF (draughting_callout_relationship);
WHERE
  WR1: 'DRAUGHTING_DIMENSION_SCHEMA.DIMENSION_GRAPH' IN
       TYPEOF (SELF\draughting_callout_relationship.
                    relating_draughting_callout);
  WR2: 'DRAUGHTING_DIMENSION_SCHEMA.DIMENSION_GRAPH' IN
       TYPEOF (SELF\draughting_callout_relationship.
                    related_draughting_callout);
END_ENTITY;
(*
```

Attribute definitions:

SELF\draughting_callout_relationship.relating_draughting_callout: the **dimension_graph** that is the predecessor in the **dimension_graph_sequence**.

SELF\draughting_callout_relationship.related_draughting_callout: the **dimension_graph** that is the successor in the **dimension_graph_sequence**.

Formal proposition:

WR1: The relating draughting callout (i.e., predecessor) shall be a **dimension_graph**.

WR2: The related draughting callout (i.e., successor) shall be a **dimension_graph**.

```
*)
END_SCHEMA; -- draughting_dimension_schema
(*
```

Annex A
(normative)

Short names of entities

Table A.1 provides the short names of entities specified in this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

Table A.1 - Short names of entities

Entity name	Short name
DIMENSION_CALLOUT	DMNCLL
DIMENSION_CURVE	DMNCRV
DIMENSION_CURVE_DIRECTED_CALLOUT	DCDC
DIMENSION_CURVE_TERMINATOR	DMCRTR
DIMENSION_GRAPH	DMNGRP
DIMENSION_GRAPH_PROJECTION_CURVE_USAGE	DGPCU
DIMENSION_GRAPH_SEQUENCE	DMGRSQ
DRAUGHTING_CALLOUT	DRGCLL
DRAUGHTING_CALLOUT_RELATIONSHIP	DRCLRL
DRAUGHTING_TITLE	DRGTTL
DRAWING_DEFINITION	DRWDFN
DRAWING_REVISION	DRWRVS
DRAWING_REVISION_SEQUENCE	DRRVSQ
DRAWING_SHEET_REVISION	DRSHRV
DRAWING_SHEET_REVISION_SEQUENCE	DSRS
DRAWING_SHEET_REVISION_USAGE	DSRU
LEADER_CURVE	LDRCRV

Table A.1 (concluded)

Entity name	Short name
LEADER_DIRECTED_CALLOUT	LDDRCL
LEADER_TERMINATOR	LDRTRM
PROJECTION_CURVE	PRJCRV
PROJECTION_DIRECTED_CALLOUT	PRDRCL
TERMINATOR_SYMBOL	TRMSYM