

INTERNATIONAL STANDARD

ISO
10303-207

First edition
1999-10-01

Corrected
2001-03-01

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

Part 207:

**Application protocol: Sheet metal die planning
and design**

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

*Partie 207: Protocole d'application: Prévision et conception des tôles d'acier
coulé*



ISO 10303-207:1999(E)

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Printed in Switzerland

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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 10303-207 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *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 33, Conformance testing methodology and framework: Structure and use of abstract test suites;
- 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;
- 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 220, Application protocol: Process planning, manufacture, and assembly of layered electronic products;
- 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 228, Application protocol: Building services: Heating, ventilation, and air conditioning;
- 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;
- 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 320, Abstract test suite: Process planning, manufacture, and assembly of layered electronic products;
- 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;
- Part 325, Abstract test suite: Building elements using explicit shape representation;

- Part 326, Abstract test suite: Ship mechanical systems;
- Part 327, Abstract test suite: Plant spatial configuration;
- Part 328, Abstract test suite: Building services: Heating, ventilation, and air conditioning;
- Part 329, Abstract test suite: Exchange of design and manufacturing product information for forged parts;
- 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 this International Standard reflects its structure:

- Parts 11 to 13 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.

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

Annexes A, B, C, D, E, and F form an integral part of this part of ISO 10303. Annexes G, H, J, K, L, M, and N of this part of ISO 10303 are for information only.

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. A complete list of parts of ISO 10303 is available from the Internet:

<<http://www.nist.gov/sc4/editing/step/titles/>>

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 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 application protocol series.

This part of ISO 10303 specifies an application protocol (AP) for the exchange of sheet metal part design, part manufacture, and tool design information between contractors and suppliers. This exchange may be within enterprises, as when one department of an enterprise acts as a contractor, exchanging data with another department that acts as a supplier. This exchange may also be between enterprises, as when one enterprise, the contractor, exchanges information with another enterprise, the supplier. This AP satisfies an industrial need to exchange information to enable a contractor to manufacture a die tool used in the production of a sheet metal part. The information includes any combination of the following:

- Exchange of necessary information, such as sheet metal part geometry and configuration data, part tolerances, and part materials, from a contractor to a supplier to enable the supplier to produce a plan for manufacturing that sheet metal part;
- Exchange of necessary information, such as sheet metal part geometry and configuration data, part tolerances, and part materials, from a contractor to a supplier to enable the supplier to produce the design of a sheet metal die set (see figure 1);
- Exchange from a supplier to a contractor of a plan for the manufacture of a sheet metal part, possibly including press and process data, and plant constraint information;
- Exchange from a supplier to a contractor of the design of a sheet metal die, including die geometry and presentation data, die material data, die component configuration, and inter-relationships among the die component representations.

More information on the sheet metal forming process is included in annex L.

This application protocol defines the context, scope, and information requirements for sheet metal die planning and design, and specifies the integrated resources necessary to satisfy these requirements.

Figure 2 contains the data planning model that provides a high level description of the requirements for this application protocol, as well as the relationships between the basic data components.

The planning model contains items, which are the representation of actual physical objects and their classification. Items are defined by item definitions. The item definitions describe whether they are standard or designed, and whether they are a part, die, or material. Item definitions may include features that are areas of interest on an item. A feature on a die may be a depression into which a boss on a press may be inserted; the purpose of describing the depression as a feature would be for the purpose of associating the use of the depression, which is fixturing, with the geometry of the depression.

Shape Definition Representation describes the shape of the item or the shape of a feature of the item. This representation is either a wireframe, surface, or solid. Shape Definition Representation also includes the physical model identification, tolerances, and the part shape relationship to the die shape.

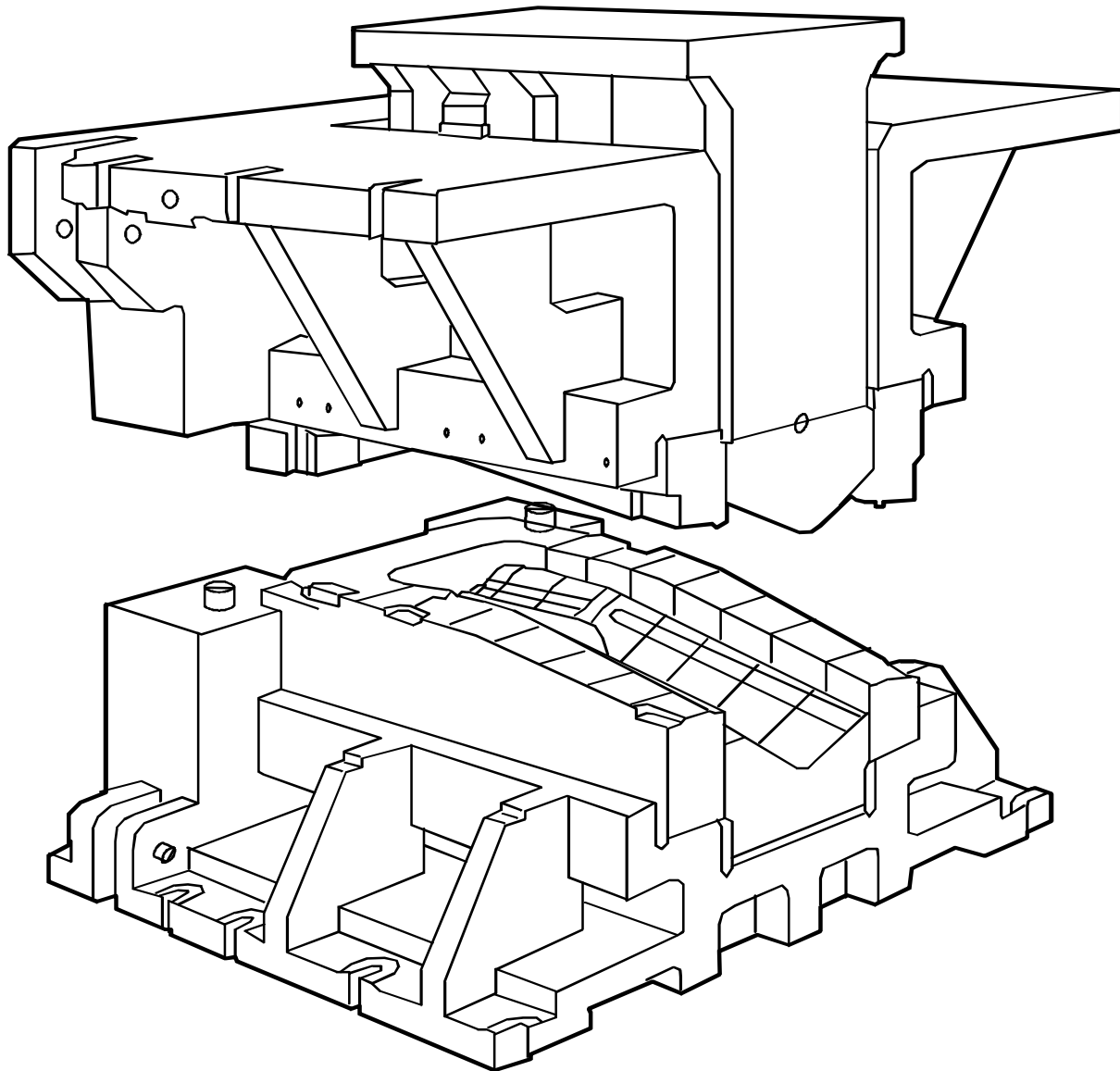


Figure 1 - Typical sheet metal die set

Part Process Plans define the manufacture of the part using dies as tools. The designs of both parts and dies are item definitions. Constraints, versions and component operations are included in the part process plans.

Work leads to the creation or modification of an item definition. A work request results in the development of part process plans.

Application protocols provide the basis for developing implementations of ISO 10303 and abstract test suites for the conformance testing of AP implementations.

Clause 1 defines the scope of the application protocol and summarizes the functionality and data covered by the AP. Clause 3 lists the words defined in this part of ISO 10303 and gives pointers to words defined elsewhere. An application activity model that is the basis for the definition of the scope is provided in annex G. The information requirements of the application are specified in clause 4 using terminology appropriate to the application. A graphical representation of the information requirements, referred to as the application reference model, is given in annex H.

Resource constructs are interpreted to meet the information requirements. This interpretation produces the application interpreted model (AIM). This interpretation, given in 5.1, shows the correspondence between the information requirements and the AIM. The short listing of the AIM specifies the interface to the integrated resources and is given in 5.2. Note that the definitions and EXPRESS provided in the integrated resources for constructs used in the AIM may include select list items and subtypes that are not imported into the AIM. The expanded listing given in Annex A contains the complete EXPRESS for the AIM without annotation. A graphical representation of the AIM is given in annex J. Additional requirements for specific implementation methods are given in annex D.

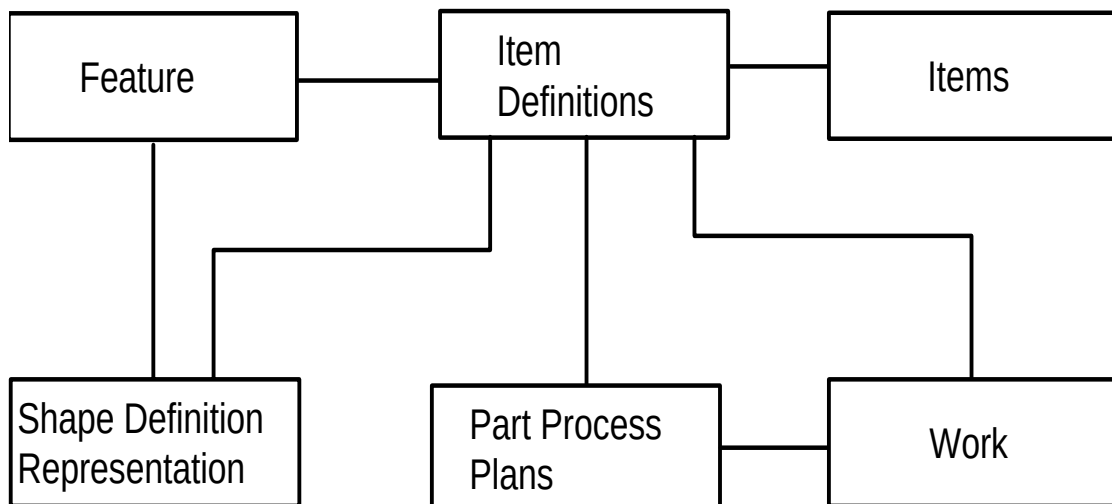


Figure 2 - Data planning model

Industrial automation systems and integration — Product data representation and exchange — Part 207: Application protocol: Sheet metal die planning and design

1 Scope

This part of ISO 10303 specifies the use of the integrated resources necessary for the scope and information requirements for the exchange of information between contractors and suppliers to enable the eventual manufacture of sheet metal dies used in the production process of sheet metal parts.

NOTE 1 - The application activity model, in annex G, provides a graphical representation of the processes and information flows that are the basis for the definition of the scope of this part of ISO 10303.

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

— Types of products supported:

NOTE 2 - This list describes the types of products for which data are in scope. The list following this one describes types of product data which are in scope.

a) Sheet metal part design data;

EXAMPLE 1 - Sheet metal part designs may be for sheet metal parts intended for the exterior of a product, those intended for the interior of a product, those intended to be in view or not in view on the final product, or those intended to support loads or maintain structure of a product. Sheet metal part designs may also be for sheet metal parts that are products in themselves.

b) Sheet metal die design data, including die face design and die structure design, for an individual die against which sheet metal is formed by processes that do not involve a mating die;

c) Sheet metal die set design data, including die face design and die structure design, for die sets used in a stamping press machine to manufacture sheet metal parts;

d) Sheet metal part manufacture description data.

— Types of product data supported:

- a) Design data for materials, sheet metal in-process parts, sheet metal parts, die components, individual dies, and die sets;
- b) Process data for sheet metal part manufacture;
- c) Change and schedule data for design of product definition data and manufacture description data;
- d) Data ownership, generating system information, and exchange history surrounding product definition data and manufacture description data;
- e) The identification of externally designed parts and purchased items;
- f) Design constraints on dies;
- g) Wireframe, surface, and solid geometry;
- h) Data describing the relative position of materials and in-process sheet metal parts to the die or dies that will further form them;
- i) Composition of materials, sheet metal parts, and die components;
- j) Properties associated with materials or with collections of geometric representations, such as hardness, porosity, method of manufacture, and function.

— Stages in the product life cycle supported are data at any stage of completion that describe:

- a) Materials;
- b) Sheet metal in-process parts and sheet metal parts;
- c) Die components, individual dies, and die sets;
- d) Sheet metal part manufacture description data;
- e) Change and schedule data for design of product definition data and manufacture description data.

— The supported exchange scenarios from contractor to supplier are as follows:

- a) requirements to enable the supplier to create a sheet metal part processing plan for the contractor, such as the sheet metal part design, available presses and plants, and plant and press constraints;

b) requirements to enable the supplier to create a die design for the contractor, such as the sheet metal part design and the sheet metal part processing plan. This design may be for the die face, or for the die structure, or for both;

NOTE 3 - Requests for changes by contractors are considered to be the exchange of additional requirements.

c) exchanges wherein the contractor and supplier are divisions of the same company;

d) exchanges wherein the contractor and supplier are different companies.

— The supported exchange scenarios from supplier to contractor are as follows:

a) a part process plan or any portion thereof;

b) a complete die design or any portion thereof;

c) a die face design or any portion thereof;

d) a die structure design or any portion thereof;

e) a change request;

f) exchanges wherein the contractor and supplier are divisions of the same company;

g) exchanges wherein the contractor and supplier are different companies.

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

— Parts that are not made of sheet metal or are not manufactured by a process involving the use of a die or dies;

— Sheet metal parts that are manufactured by explosive forming, forging, or powdered metal processing;

— The design of devices used to stretch sheet metal over single convex dies, or the rubber bladder or sheet used in hydroforming or trap rubber forming to force sheet metal into a single concave die;

— Parametric or variational geometry models of sheet metal parts, dies, or die components;

— Engineering analysis data of any kind;

— Financial data of any kind;

— Manufacturing process data for sheet metal dies;

- Any exchange uses of data in order to:
 - a) enable the initial design of sheet metal parts;
 - b) enable the design of checking fixtures;
 - c) enable the manufacture of the die.
- Data related to production runs of sheet metal parts.

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

ISO 31:1992, *Quantities and units (all parts)*.

ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*.

ISO 8601:1988, *Data elements and interchange formats — Information interchange — Representation of dates and times*.

ISO 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 10303-21:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 21: Implementation methods: Clear text encoding of the exchange structure*.

ISO 10303-22:—,¹⁾ *Industrial automation systems and integration — Product data representation and exchange — Part 22: Implementation methods: Standard data access interface*.

ISO 10303-31:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 31: Conformance testing methodology and framework: General concepts*.

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 resources: 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*.

¹⁾ To be published.

ISO 10303-44:1994, *Industrial automation systems and integration — Product data representation and exchange — Part 44: Integrated generic resources: Product structure configuration.*

ISO 10303-45:—,¹⁾ *Industrial automation systems and integration — Product data representation and exchange — Part 45: Integrated generic resources: Materials.*

ISO 10303-47:—,¹⁾ *Industrial automation systems and integration — Product data representation and exchange — Part 47: Integrated generic resources: Shape variation tolerances.*

ISO 10303-49:—,¹⁾ *Industrial automation systems and integration — Product data representation and exchange — Part 49: Integrated generic resources: Process structure and properties.*

ISO/TR 10303-307:—,¹⁾ *Industrial automation systems and integration — Product data representation and exchange — Part 307: Abstract test suite for Sheet metal die planning and design.*

¹⁾To be published.

3 Definitions

3.1 Terms defined in ISO 8601

This part of ISO 10303 makes use of the following terms defined in ISO 8601:

- calendar date;
- calendar week;
- day;
- Gregorian calendar;
- hour;
- leap year;
- minute;
- month;
- second;
- week;
- year.

3.2 Terms defined in ISO 10303-1

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

- abstract test suite (ATS);
- application;
- application activity model (AAM);
- application context;
- application interpreted model (AIM);
- application protocol (AP);

- application object;
- application reference model (ARM);
- assembly;
- conformance class;
- conformance requirement;
- context;
- data;
- data exchange;
- implementation method;
- information;
- integrated resource;
- interpretation;
- PICS proforma;
- protocol implementation conformance statement (PICS);
- product;
- product data;
- structure;
- unit of functionality (UoF).

3.3 Terms defined in ISO 10303-31

This part of ISO 10303 makes use of the following terms defined in ISO 10303-31:

- conformance testing;
- postprocessor;
- preprocessor.

3.4 Terms defined in ISO 10303-42

This part of ISO 10303 makes use of the following terms defined in ISO 10303-42:

- arcwise connected;
- bounds;
- boundary;
- closed surface;
- connected;
- connected component;
- curve;
- cycle;
- dimensionality;
- domain;
- euler equations;
- extent;
- finite;
- graph;
- handle;

- inside;
- interior;
- list;
- *d*-manifold with boundary;
- orientable;
- overlap;
- set;
- space dimensionality;
- surface.

3.5 Terms defined in ISO 10303-43

This part of ISO 10303 makes use of the following terms defined in ISO 10303-43:

- coordinate space;
- geometrically founded.

3.6 Terms defined in ISO 10303-44

This part of ISO 10303 makes use of the following terms defined in ISO 10303-44:

- bill-of-material structure (BOM);
- component;
- constituent;
- effectivity;
- link;
- lot;
- node;

- parts list structure;
- promissory use;
- root node;
- tree.

3.7 Terms defined in ISO 10303-202

This part of ISO 10303 makes use of the following terms defined in ISO 10303-202:

- application interpreted construct (AIC).

3.8 Other definitions

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

3.8.1 cam: a mechanical unit integral to a die set that is used to apply supplementary forming or shearing forces to sheet metal in directions not parallel to the direction of closure of the die set.

3.8.2 contractor: a person or an organization that awards a contract for the production of either a design for something, a plan for the production of something, or a physical object.

3.8.3 die: a single piece of metal that is brought into contact with sheet metal to form, impress, or shear it. A die that is used without a mating die (see 3.8.11) serves as a form against which sheet metal may be stretched, compressed, or hammered by tools other than dies. A die may also have one or more mating dies (see 3.8.11).

3.8.4 die face: those die surfaces that directly contact the sheet metal during the operation of the stamping press containing the die, plus the surfaces that provide contiguity to these contacting surfaces.

NOTES

1 - All die faces that are parts of dies belonging to die sets are enclosed within the die set when it is shut.

2 - Surfaces of the die face are commonly called active surfaces, addendum surfaces, and sculpted surfaces.

3.8.5 die set: a set of two or more mating dies (see 3.8.11) that act as a single tool to form, impress, or shear sheet metal when mounted in a stamping press (see 3.8.16).

NOTE - A die set may include zero or more cams.

3.8.6 die structure: the portions of a die that provide structural rigidity, support the weight and support the in-process stresses of the die.

NOTE - The die structure is essentially all portions of a die that are not part of the die face.

3.8.7 feature: an area of interest on an item that is described as a unit for some purpose. A feature serves as a means of calling attention to or attaching properties to any portion of an item design. The allowable items to which a feature applies are parts, materials or die components.

NOTES

1 - A portion is either a subset of the item design, or is the entire design.

2 - A feature may exist without feature properties attached to it. Such a feature may be noted because it is a subset of an item design that is frequently incorporated in other designs.

3.8.8 feature property: data that are associated with all or a portion of the design of an item. Feature properties are design intent, styling, material composition, method of manufacture, function, or physical properties.

3.8.9 hard aid: a physical model of a shape, part, or product.

NOTE - Hard aids may be made of wood, clay, plaster, or other materials. Hard aids are used when the source of design data are a physical model, as frequently occurs in styling or prototyping work.

3.8.10 in-process: a description of a process that has more than one manufacturing process before the item is completed.

3.8.11 mating die: a die that has a die face (see 3.8.4) that mates with a die face of another die.

3.8.12 part process plan: the detailed plan for the manufacture of a part. It includes a sequence of steps to be executed that call out the selected machines, fabrication, operation steps, setups, routings, and in-process inspection requirements employed to produce a part.

3.8.13 sheet metal: metal in a form in which the thickness is substantially less than the width or length.

NOTE - The maximum metal thickness permitted for metal to be considered sheet metal varies between industries. In the automotive industry, this maximum is 13 millimeters. In aerospace, it is 7 millimeters.

3.8.14 sheet metal part: a part that is not an assembly of other parts but that either is a product or is intended to be assembled into a product, and that is sheet metal or is fabricated from sheet metal (see 3.8.13).

3.8.15 sheet metal part process plan: a part process plan (see 3.8.12) for a sheet metal part (see 3.8.14).

3.8.16 stamping press: a machine that applies force to close and open a die set (see 3.8.5) on a sheet metal work piece in order to form it.

NOTE - Annex L describes stamping presses in more detail.

3.8.17 supplier: a person or organization responsible for producing that design, plan, or physical object under the terms of a contract.

3.9 Abbreviations

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

- AAM Application Activity Model;
- AIC Application Interpreted Construct;
- AIM Application Interpreted Model;
- AP Application Protocol;
- ARM Application Reference Model;
- ATS Abstract Test Suite;
- B-rep Boundry representation;
- CMM Coordinate Measuring Machine;
- ICOM Input, Control, Output, Mechanism;
- IDEF0 Integration Definition for Function Modeling;
- IDEF1X Integration Definition for Information Modeling;
- NC Numeric Control;
- OPT Optional
- PICS Protocol Implementation Conformance Statement;
- UoF Unit of Functionality.

4 Information requirements

This clause specifies the information required for sheet metal die planning and design.

The information requirements are specified as a set of units of functionality, application objects, and application assertions. These assertions pertain to individual application objects and to relationships between application objects. The information requirements are defined using the terminology of the subject area of this application protocol.

NOTES

- 1 - A graphical representation of the information requirements is given in annex H.
- 2 - The information requirements correspond to those of the activities identified as being within the scope of this application protocol in annex G.
- 3 - The mapping table specified in 5.1 shows how the integrated resources <and application interpreted constructs> are used to meet the of this application protocol.

4.1 Units of functionality

This subclause specifies the units of functionality for the Sheet metal die planning and design application protocol. This part of ISO 10303 specifies the following units of functionality:

- feature;
- item;
- item_definition;
- item_definition_relationship;
- item_version;
- part_process_plan;
- product;
- representation_element;
- shape_definition;
- shape_definition_relationship;

- tolerance;
- work_order;
- work_request.

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

4.1.1 feature

The feature UoF represents areas of interest on an item that are described as a unit for some purpose. These areas of interest may serve as a means of calling attention to, or attaching properties to, all or a portion of the design of an item.

EXAMPLE 2 - When a die is intended to be loaded into a press using a crane, a hole feature may be designed in the die to accommodate the hook of the crane.

The following application objects are used by feature UoF:

- feature;
- feature_property.

4.1.2 item

The item UoF represents actual physical objects and their classifications.

The following application objects are used by item UoF:

- die;
- item;
- item_classification;
- item_classification_relationship;
- material;
- part.

4.1.3 item_definition

The item_definition UoF represents various designs of an item and its classifications.

The following application objects are used by item_definition UoF:

- designed_item;
- die_definition;
- external_item_reference;
- final_part_definition;
- in_process_part_definition;
- item_definition;
- material_definition;
- part_definition;
- scrap_definition.

4.1.4 item_definition_relationship

The item_definition_relationship UoF represents the relationship between the design of one item and the design of another item.

The following application objects are used by item_definition_relationship UoF:

- assembly_component_relationship;
- input_item_die_relationship;
- item_definition_relationship;
- make_similar_to_relationship;
- mating_relationship;
- specified_material_relationship;

- symmetrical_item_relationship.

4.1.5 item_version

The item_version UoF represents versions of items and distinguishes whether they are intended for manufacture internally or externally to the organization that designed them.

The following application objects are used by item_version UoF:

- item_version;
- made_in_house;
- purchased.

4.1.6 part_process_plan

The part_process_plan UoF represents part process plans and their constraints, versions, and component operations.

The following application objects are used by part_process_plan UoF:

- die_definition_constraint;
- part_process_plan;
- part_process_plan_template;
- part_process_plan_version_relationship;
- plant_constraint;
- press_definition;
- process_operation.

4.1.7 product

The product UoF represents the physical product and both where and when given parts are located within it.

The following application objects are used by product UoF:

- marketable_assembly;

- part_on_product;
- part_on_product_location;
- production_effectivity.

4.1.8 representation_element

The representation_element UoF contains representations of elements within overall shapes. These representations include mathematical and physical representations.

The following application objects are used by representation_element UoF:

- angle_distance_dimension;
- curve_distance_dimension;
- curve_length_size_dimension;
- diameter_size_dimension;
- dimensional_representation;
- distance_dimension;
- linear_distance_dimension;
- physical_representation;
- position_orientation_representation;
- radius_size_dimension;
- representation_element;
- size_dimension;
- solid_representation;
- surface_representation;
- wireframe_representation.

4.1.9 shape_definition

The shape_definition UoF represents the shapes of entire items or areas of interest on items that comprise less than entire items.

The following application objects are used by shape_definition UoF:

- die_shape_definition;
- feature_shape_definition;
- material_shape_definition;
- part_shape_definition;
- shape_definition.

4.1.10 shape_definition_relationship

The shape_definition_relationship UoF represents relationships between shapes.

The following application objects are used by shape_definition_relationship UoF:

- envelope_relationship;
- shape_definition_relationship;
- similarity_relationship.

4.1.11 tolerance

The tolerance UoF represents design allowable deviations on measurements and positions of elements within shapes.

The following application object is used by tolerance UoF:

- coincidence_defaults;
- dimension_tolerance_range;
- shape_tolerance;

- tolerance_bound;
- tolerance_value.

4.1.12 work_order

The work_order UoF represents work which has been assigned and all of the classifications of directives for that work to be done.

The following application objects are used by work_order UoF:

- change_order;
- external_order;
- internal_order;
- start_order;
- work_item;
- work_order;
- work_order_relationship;
- work_order_responsibility.

4.1.13 work_request

The work_request UoF represents the classifications of solicitations for work to be done.

The following application objects are used by work_request UoF:

- change_request;
- start_request;
- work_request.

4.2 Application objects

This subclause specifies the application objects for the sheet metal die planning and design application protocol. Each application object is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the object. The application objects and their definitions are given below.

4.2.1 Angle_distance_dimension

An Angle_distance_dimension is a type of Distance_dimension (see 4.2.16) where the distance is calculated between two elements converging on a common point or line, measured in units of angle measure. The data associated with an Angle_distance_dimension are the following:

- clockwise;
- orientation.

4.2.1.1 clockwise

The clockwise specifies whether or not the dimension is measured in a clockwise direction from the geometric basis element to the geometric target element.

4.2.1.2 orientation

The orientation specifies the vector that defines the right-hand-rule to be used in determining the direction of measurement specified by the clockwise attribute.

4.2.2 Assembly_component_relationship

An Assembly_component_relationship is a type of Item_definition_relationship (see 4.2.31) describing the immediate assembly context of every component and subassembly, and conversely, the component and subassembly composition of every assembly of a die or sheet metal part. The data associated with an Assembly_component_relationship is component_quantity.

The component_quantity specifies the number of components used in the construction of the assembly to which they belong.

NOTE - The item_definitions playing the roles of component and assembly must both be of the same item_definition_type, and must be either a "part_definition" or "die_definition".

4.2.3 Change_order

A Change_order is a type of Work_order (see 4.2.74) that requires modifications to a previous work effort. Items modified include part designs, die designs and part process plans. The data associated with a Change_order are the following:

- change_design_location;
- implementor.

4.2.3.1 change_design_location

The change_design_location specifies the location of the aspect of a design or a step in a process plan that needs to be changed.

EXAMPLE 3 - When an aspect of a design or a step in a process plan is to be changed, the location of the intended change within the context of the overall design needs to be specified. One possible instance of this specification would be if the shape of a hole in the design of a sheet metal part needed to be changed. A circle might be drawn around the representation of that hole as it appeared on a paper plot of the overall part design. This circle would indicate the location where the Change_order change is intended to occur. Similarly in a process plan if a trim die operation step needs to be replaced by draw die operation, the change might be indicated by highlighting the process operation step.

4.2.3.2 implementor

The implementor specifies the person, organization, or both responsible for implementing the change.

4.2.4 Change_request

A Change_request is a type of Work_request (see 4.2.77) that solicits change to some aspect of a part design, die design or process plan. The data associated with a Change_request are the following:

- problem_change_description;
- recommended_solution.

4.2.4.1 problem_change_description

The problem_change_description specifies a problem with a part design, die design or process plan. Problem change descriptions may be defined textually, graphically or a combination of both.

4.2.4.2 recommended_solution

The recommended_solution specifies how a change should be implemented to resolve a problem with a part design, die design or process plan. There may be more than one recommended_solution for a Change_request.

4.2.5 Coincidence_defaults

A `Coincidence_defaults` is a description of the limits of positional variance between two elements of a CAD model under which the two elements will be considered to be coincident. The data associated with a `Coincidence_defaults` are the following:

- position;
- angle.

EXAMPLE 4 - A model in a CAD System A consists of two points separated by 1.0 mm. CAD System A requires a linear separation between points to equal or exceed 0.1 mm in order to be considered non-coincident. Therefore CAD System A has a `coincidence_defaults.position` equal to 0.1 mm. CAD System B has a greater `coincidence_defaults.position`, equal to 1.0 mm. Therefore if the model from CAD System A is transferred to CAD System B, the two points will be considered to be coincident there.

4.2.5.1 position

The position specifies the maximum linear separation condition between two points under which they will be considered to be coincident.

4.2.5.2 angle

The angle specifies the maximum angular separation condition between two elements under which they will be considered to be coincident.

4.2.6 Curve_distance_dimension

A `Curve_distance_dimension` is a type of `Distance_dimension` (see 4.2.16) where the distance is calculated between two elements along a path defined by a third element of geometry.

4.2.7 Curve_length_size_dimension

A `Curve_length_size_dimension` is a type of `Size_dimension` (see 4.2.63) where the element to be measured is a curve and the measurement is to be along the entire path of the curve.

4.2.8 Designed_item

A `Designed_item` is a type of `Item_definition` (see 4.2.30) that is a part design or die design that is created internal to a business organization rather than created externally. The data associated with a `Designed_item` are the following:

- creation_date_and_time;
- data_exchange_history;
- data_ownership;
- designer;
- generating_system_information;
- media_requirements.

EXAMPLE 5 - A standard fastener is an example of an externally designed item.

4.2.8.1 creation_date_and_time

The creation_date_and_time specifies the date and optionally the time that a Designed_item was created.

4.2.8.2 data_exchange_history

The data_exchange_history specifies the software, hardware, and sequence of all translations of the designed_item since that or those translations specified by the generating_system_information. There may be more than one data_exchange_history for a Designed_item.

4.2.8.3 data_ownership

The data_ownership specifies all the organizations and associated personnel that have ownership of part or die design data. Included in this information is ownership history. There may be more than one data_ownership for a Designed_item.

4.2.8.4 designer

The designer specifies the person and organization that designed the item. The information includes names, addresses, and phone numbers of people and organizations who created the design of a part or die Item. There may be more than one designer for a Designed_item.

4.2.8.5 generating_system_information

The generating_system_information specifies a reference to a document, electronic file, or other source that specifies the software, hardware, and file names where the original part or die design information was generated. The original data set location, the name of the user who created it, and the creating organization, with all relevant addresses and phone numbers, are included. There may be more than one generating_system_information for a Designed_item.

4.2.8.6 media_requirements

The media_requirements specifies the expected format and media to be used for the designed data information. There may be more than one media_requirements for a Designed_item.

EXAMPLE 6 - Media requirements may state whether information is to be plotted on paper or provided in a specified electronic format. A media_requirement might specify that the shape_definition of a die is to be presented in a proprietary corporate format while the bill of material should be presented on a specific paper form.

4.2.9 Diameter_size_dimension

A Diameter_size_dimension is a type of Size_dimension (see 4.2.63) where the element to be measured is circular and the measurement is the diametrical distance between two points on the element.

4.2.10 Die

A Die is a type of Item (see 4.2.27) that is a tool used singly, or in sets in a stamping press, to stretch, compress, or hammer sheet metal against in order to impart a desired shape to an object made of sheet metal. It may or may not include cams.

NOTE - Further explanation may be found in annex L.

4.2.11 Die_definition

A Die_definition is a type of Item_definition (see 4.2.30) that defines references that are specific to dies or their in-process or final-form components. The data associated with a Die_definition are the following:

- die_function_description;
- die_layout_specification_reference;
- die_structure_specification_reference;
- die_weight;
- pattern_casting_specification.

4.2.11.1 die_function_description

The die_function_description specifies the operation of a die assembly, subassembly or component.

4.2.11.2 die_layout_specification_reference

The `die_layout_specification_reference` specifies the particular manuals and sections within manuals that detail the methods and standards used to design the die face. There may be more than one `die_layout_specification_reference` for a `Die_definition`.

4.2.11.3 `die_structure_specification_reference`

The `die_structure_specification_reference` specifies the particular manuals and sections within manuals that detail the methods and standards used to design the structural elements of dies. There may be more than one `die_structure_specification_reference` for a `Die_definition`.

4.2.11.4 `die_weight`

The `die_weight` specifies the weight of a die component, subassembly or fully assembled die set, and whether it is estimated, calculated, or measured.

4.2.11.5 `pattern_casting_specification`

The `pattern_casting_specification` specifies an already manufactured pattern or an existing casting design to be used to obtain the casting from which the die component will be machined. This attribute only applies to die components that are not assemblies.

NOTE - This application element is a reference to either a physical object or to a CAD design.

4.2.12 `Die_definition_constraint`

A `Die_definition_constraint` is a description of a restriction on how a die is defined. A `Die_definition_constraint` is commonly a `Plant_constraint` (see 4.2.50), a `Press_definition` (see 4.2.52), or another kind of constraint as described in the `constraint_description` attribute of this entity. The data associated with a `Die_definition_constraint` is `constraint_description`.

The `constraint_description` specifies a description of the `Die_definition_constraint` and also specifies that a `Die_definition_constraint` is neither a `Plant_constraint` nor a `Press_definition`.

NOTES

1 - IDEF1X occasionally is incapable of modelling category relationships when the candidate generic entity and one or more of its candidate category entities participate in circular relationships. The IDEF1X terms generic and category correspond to supertype and subtype in EXPRESS terminology. A `Die_definition_constraint` is such a candidate generic entity as depicted in the ARM diagrams. Therefore it is modelled as an entity which "is" zero or one of each of the two entities which would have been its category entities. In addition, the note following has been added to the ARM diagram to ensure that the `Die_definition_constraint` is treated as a generic entity.

2 - Each instance of `Die_definition_constraint` is either a `Press_definition`, a `Plant_constraint`, or neither of them.

EXAMPLES

7 - Items such as plant crane capacity, material handling capabilities and plant layout restrict the manner in which a die may be designed.

8 - Examples of `Die_definition_constraints` which are neither examples of `Plant_constraints` nor of `Press_definitions` include temperature or humidity variation where a die set will be installed, projected in-process stress on a die, and the coefficient of thermal expansion of the steel from which the die will be cast.

4.2.13 Die_shape_definition

A `Die_shape_definition` is a type of `Shape_definition` (see 4.2.59) where the shape being described is that of a die or die component.

4.2.14 Dimension_tolerance_range

A `Dimension_tolerance_range` is a range of values within which the realization of a `Dimensional_representation` may fall and still comply with the design specification.

NOTE - Instances of `Dimension_tolerance_range` either have a non-blank value for their `tolerance_fitting_type` attribute, or non-blank values for all of their associated `Tolerance_value` instances; but never do both situations occur simultaneously.

EXAMPLE 9 - The range of values can be specified in many ways. In sheet metal design of the active surfaces of a die or of the shape of the formed sheet metal, tolerances may often be implied by the number of digits given in the `Dimensional_representation`. For example, if 7.0 mm is specified, it is assumed that the actual measure may vary between 6.9 and 7.1 mm. If 7.00 mm were specified, the actual measure could vary between 6.99 and 7.01 mm. Other sheet metal designers use a similar form of implicit tolerance known as significant digits or rounding tolerance. These represent the range of values that would round to the specified measure. For example, if 7.0 mm is specified, it is assumed that the actual measure may vary between 6.95 and 7.04 mm. If 7.00 mm were specified, the actual measure could vary between 6.995 and 7.004 mm.

The data associated with a `Dimension_tolerance_range` is `tolerance_fitting_type`.

The `tolerance_fitting_type` specifies the class of hole and shaft fit. The `tolerance_fitting_type` need not be specified for a particular `Dimension_tolerance_range`.

4.2.15 Dimensional_representation

A `Dimensional_representation` is a type of `Representation_element` (see 4.2.57) in which the shape of an object is represented in terms of a series of dimensional units and values.

EXAMPLE 10 - The representation of a piece of sheet metal may be that it is 2 meters long by 1 meter wide by 3 millimeters thick.

4.2.16 Distance_dimension

A Distance_dimension is a type of Dimensional_representation (see 4.2.15) that is a calculation of the distance between two elements of geometry or annotation. Each Distance_dimension is either an Angle_distance_dimension (see 4.2.1), a Curve_distance_dimension (see 4.2.6), or a Linear_distance_dimension (see 4.2.33).

4.2.17 Envelope_relationship

An Envelope_relationship is a type of Shape_definition_relationship (see 4.2.60) in which one Shape_definition plays the role of envelope for another Shape_definition. It is possible to have multiple Envelope_relationships for the same pair of Shape_definitions.

EXAMPLE 11 - A design may be developed within a constraint requiring it to have a Shape_definition that fits within a boundary. The boundary may also be defined as a Shape_definition. The relationship between the boundary Shape_definition and the design Shape_definition is an Envelope_relationship type of Shape_definition_relationship

4.2.18 External_item_reference

An External_item_reference is a type of Item_definition (see 4.2.30) in which the definition of the item may be described in terms of or as an item that has been externally originated. An external item is an item that is typically procured rather than designed. The data associated with an External_item_reference are the following:

- manual_reference_description;
- name;
- needed_modifications.

4.2.18.1 manual_reference_description

The manual_reference_description specifies page and paragraph references within books and manuals that contain external item information.

4.2.18.2 name

The name specifies the name by which the external item is known.

4.2.18.3 needed_modifications

The needed_modifications specifies any changes that need to be made to the external item in order to make use

of the item. The needed_modification need not be specified for a particular External_item_reference. There may be more than one needed_modifications for an External_item_reference.

4.2.19 External_order

An External_order is a type of Work_order (see 4.2.74) in which the requested work will be done by an organization outside of the one placing the order. The data associated with an External_order are the following:

- contractual_requirement;
- purchase_order_number;
- purchasing_agent;
- supplier_identification.

4.2.19.1 contractual_requirement

The contractual_requirement specifies the terms of the contract between the contractor and the supplier responsible for carrying out the work outlined in the external_order. There may be more than one contractual_requirement for an External_order.

4.2.19.2 purchase_order_number

The purchase_order_number specifies the External_order for the supplier.

4.2.19.3 purchasing_agent

The purchasing_agent specifies the people and associated departments or internal organizations responsible for procuring the services of a supplier to service the External_order. There may be more than one purchasing_agent for an External_order.

4.2.19.4 supplier_identification

The supplier_identification specifies the supplier who is servicing the External_order. The identification information includes the name, address, phone number and any other unique identification of a supplier business organization. There may be more than one supplier_identification for an External_order.

4.2.20 Feature

A Feature is an area of interest on an Item (see 4.2.27) that is described as a unit for some purpose. The data associated with a feature are the following:

- designer;
- feature_name.

EXAMPLE 12 - Possible Features include adhesive locations, beads, bends, body lines, breaklines, cutouts, dimples, feature lines, flange lines, holes, joggles, locating points, lock stops, machinable areas, master control surfaces, mold points, overcrows, overdraws, periphery trim, sausages, slots, tooling holes, trim lines, weld spots, and work lines.

NOTE - The data feature_identification has been removed and will be mapped to the attribute identifier when it is available in ISO 10303-41.

4.2.20.1 designer

The designer specifies the designer of the particular feature being defined as part of an Item_definition.

4.2.20.2 feature_name

The feature_name specifies the class of Feature as a descriptive label.

4.2.21 Feature_property

The Feature_property is the description of a property and associated values that are attached to a feature of a part or die component. The data associated with a Feature_property are the following:

- property_description;
- property_type.

EXAMPLE 13 - Possible properties of features include skin quality, grain direction, surface finish, surface quality, heat treat information, finish coats, springback, coating properties, and key characteristics.

NOTE - The data feature_property_identification has been removed and will be mapped to the attribute identifier when it is available in ISO 10303-41.

4.2.21.1 property_description

The property_description specifies the property measurements associated with a Feature. This property description may be textual or may be a value with a specified unit. This property may or may not be intrinsic to a material.

4.2.21.2 property_type

A `property_type` specifies the class of property.

4.2.22 Feature_shape_definition

A `Feature_shape_definition` is a type of `Shape_definition` (see 4.2.59) in which the shape being described is that of a Feature. The `Feature_shape_definition` may describe the shape of a Feature on a part whose shape is defined by a `Part_shape_definition` (see 4.2.48).

4.2.23 Final_part_definition

A `Final_part_definition` is a type of `Part_definition` (see 4.2.42) that is the output of the final die operation performed on the part prior to any assembly work.

4.2.24 In_process_part_definition

An `In_process_part_definition` is a type of `Part_definition` (see 4.2.42) in which the part being defined is of an in-process sheet metal part that is intended to be operated upon by a manufacturing process. A series of one or more manufacturing processes acting upon one or more in-process part definitions will produce as the final output a part defined by a `Final_part_definition` (see 4.2.23). As such, an `in_process_part_definition` is the design of a sheet metal part in terms of the requirements for operation by a subsequent manufacturing process.

4.2.25 Input_item_die_relationship

An `Input_item_die_relationship` is a type of `Item_definition_relationship` (see 4.2.31) that describes a relationship between input parts or materials or scrap and the die that modifies them. The input part or material or scrap is the in-process part or raw material or by-product of a previous process that will be stamped by a die in a press operation. This relationship also describes the positioning and orientation of the item within the die. The `item_definition` playing the role of `input_item` shall be of `item_definition_type` "part_definition", "material_definition", or "scrap_definition", and that playing the role of die must be of `item_definition_type` "die_definition".

4.2.26 Internal_order

An `Internal_order` is a type of `Work_order` (see 4.2.74) in which the work described by the `Work_order` is planned to be done within an organization. The data associated with an `Internal_order` are the following:

- `authorized_hours`;
- `charge_number`;
- `source_department`.

4.2.26.1 authorized_hours

The `authorized_hours` specifies the maximum number of man hours that will be allocated for completing the terms of the `Internal_order`.

4.2.26.2 charge_number

The `charge_number` specifies a project against which the hours or cost of completing the `Work_order` may be charged.

4.2.26.3 source_department

The `source_department` specifies the group that drafted and requested the `Internal_order`. Information describing the `source_department` includes any organization identifiers, the name of the department, department address, and department phone number. There may be more than one `source_department` for an `Internal_order`.

4.2.27 Item

An `Item` is an object in the scope of the subject of sheet metal that is, or is intended to be, produced. An `Item` may be one of the following: a `Die` (see 4.2.10), a `Material` (see 4.2.37), or a `Part` (see 4.2.41). The data associated with an `Item` are the following:

- `item_description`;
- `item_name`;
- `item_number`.

4.2.27.1 item_description

The `item_description` specifies the description of an object in the scope of the subject of sheet metal.

4.2.27.2 item_name

The `item_name` specifies the name of an object in the scope of the subject of sheet metal.

4.2.27.3 item_number

The `item_number` specifies a unique identification of a manufactured object in the scope of the subject of sheet metal.

4.2.28 Item_classification

An `Item_classification` specifies a categorization of an `Item`. This classification is intended to be used so that designers may easily reference similar designs done in the past. The data associated with an `Item_classification` are the following:

- `classification_description`;
- `classification_identification`;
- `classification_name`.

4.2.28.1 `classification_description`

The `classification_description` specifies a human interpretable definition of the `Item_classification`.

4.2.28.2 `classification_identification`

The `classification_identification` specifies a unique identification of the `Item_classification`.

4.2.28.3 `classification_name`

The `classification_name` specifies a meaningful name for a categorization of `Items`.

EXAMPLE 14 - A `classification_name` may be deep drawn die assemblies, die shoes, or brackets.

4.2.29 `Item_classification_relationship`

An `Item_classification_relationship` is a hierarchical association of two `Item_classification` objects. The data associated with an `Item_classification_relationship` is `relationship_description`.

The `relationship_description` specifies the nature of the association between the two `Item_classification` objects.

4.2.30 `Item_definition`

An `Item_definition` is a type of `Work_item` (see 4.2.73) that is the complete description of an assembly, component, scrap, or raw material that is part or all of a sheet metal part, the scrap that results from an operation, or a stamping die. An `Item_definition` may be one of the following: either a `Designed_item` (see 4.2.8) or an `External_item_reference` (see 4.2.18). An `Item_definition` may also be one of the following: either a `Die_definition` (see 4.2.11), a `Material_definition` (see 4.2.38), a `Part_definition` (see 4.2.42), or a `Scrap_definition` (see 4.2.58). This definition includes all relevant properties of the defined item such as item relationships, the physical shape of the `Item`, and Feature characteristics. The data associated with an `Item_definition` are the following: