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

Part 227: Application protocol: Plant spatial configuration

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

Partie 227: Protocole d'application: Configuration spatiale d'usine

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10303-227 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC4, *Industrial data*.

This International Standard is organized as a series of parts, each published separately. 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 14 specify the description methods;
— Parts 21 to 29 specify the implementation methods;
— Parts 31 to 35 specify the conformance testing methodology and framework;
— Parts 41 to 50 specify the integrated generic resources;
— Parts 101 to 107 specify the integrated application resources;
— Parts 201 to 237 specify the application protocols;
— Parts 301 to 337 specify the abstract test suites;
— Parts 501 to 520 specify the application interpreted constructs.

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

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

Should further parts of ISO 10303 be published, they will follow the same numbering pattern.

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

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing products throughout their life cycle. This mechanism is suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases, and as a basis for archiving.

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 the spatial configuration information of process plants. This information includes the shape and spatial arrangement characteristics of piping system components as well as the shape and spatial arrangement characteristics of other related plant systems (i.e., electrical, instrumentation and controls, heating, ventilation and air-conditioning, and structural systems) that impact the design and layout of piping systems. In the design and fabrication of a piping system, the piping layout must be evaluated with respect to the spatial characteristics and arrangement of these related plant systems, and the requirements for clearances between systems. The complete specification of these other systems is not needed, but enough spatial information is needed to support the layout of the piping system. Users of this standard should understand the basic principles and concepts of pant and piping system design.

This AP specifies additional requirements for the exchange of information required for the design and installation of a piping system. This includes information on the piping material, process stream fluid, and the piping system functional characteristics. A process and system design specifies process requirements for a piping system that includes pipe size, design temperatures and pressures, and insulation class. The physical design uses these process requirements for the design of the piping system.

This AP also identifies and provides a functional specification of the components of the plant piping system. The design information for a piping system may specify a pump capable of maintaining a pressure and flow rate. The design will also specify the shape limitations or requirements and the location of the pump in the system, but not sufficient information for the fabrication of the pump.

The principle focus of the AP is on piping systems and the shape and spatial arrangement of systems including plant items required to ensure the physical integrity of piping systems. Figure 1 contains a 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 data planning model illustrates that a plant consists of plant items and that plant items may be connected to one another using connectors on the plant item. The data planning model also illustrates significant concepts found on piping and instrumentation diagrams (P&IDs): the functional view of the piping system (piping system functional characterization) and one kind of plant item: piping components. The shape and spatial arrangement of plant items are represented by the item shape. The shape representation may use constructive solid geometry (CSG), solid boundary representation (B-rep) geometry, wireframe geometry, or combinations of these. The plant item shape may be represented at various levels of abstraction, from an encompassing envelope to a detailed design description. The data planning model further illustrates that the concept of change is a requirement for this application protocol. Change is applicable to each individual plant item, the relationships between plant items, and to groupings of plant items. It applies to all the concepts noted on the data planning model.

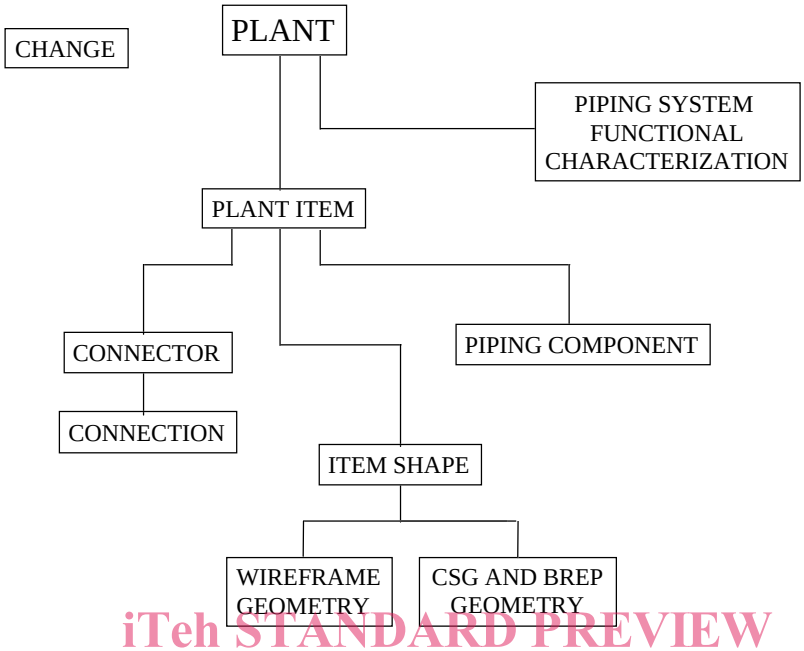

Figure 1 - Data planning model

NOTE This part of ISO 10303 may be used in conjunction with ISO 13584 [13] to identify catalogue items and classifications.

This application protocol defines the context, scope, and information requirements for the exchange of design and layout information for a plant piping system between different agents over the life cycle of a plant and specifies the integrated resources necessary to satisfy these requirements. The reasons for exchanging this information include:

— exchange of requirements from a plant owner to an engineering firm;

— exchange of piping and equipment designs from a design engineer to a plant system engineer;

— exchange of piping and equipment designs from a design engineer to a piping or equipment fabricator;

— exchange of changes to piping and equipment designs from a design engineer to a plant system engineer or a fabricator;

— exchange of piping fabrication and installation information between engineering and construction firms;

— integration of designs created by different engineers;

— detection of physical interferences of plant piping system components with components of other plant systems;

— exchange of construction specifications between engineering and construction firms;

— exchange of as-built plant and system configurations among plant owners, engineering firms and construction firms.

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 F. 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 G. A tiled "wallpaper" version of the application reference model (ARM) is given in annex M.

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 which 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 H. Additional requirements for specific implementation methods are given in annex C.

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

Part 227: Application protocol: Plant spatial configuration

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 spatial configuration information of process plants. The spatial configuration information focuses on the shape and spatial arrangement of the components of the plant piping systems. Components of the plant piping system include pipes, fittings, pipe supports, valves, in-line equipment, and in-line instruments. However, shape and spatial configuration information for equipment and non-piping plant systems are also included in this part of ISO 10303. The spatial configuration information principally supports the plant engineering design life-cycle phases, but may be useful in the downstream life-cycle phases of construction and maintenance. This part accommodates the disciplines of plant design and piping design.

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

NOTE 2 Figure 2 illustrates the basic life-cycle stages of a process plant. Plant design life-cycle phases are enclosed in a box labeled AP 227 - Plant Design (solid line). Downstream life-cycle phases for which AP 227 may be useful are enclosed in a box labeled AP 227 (dashed line).

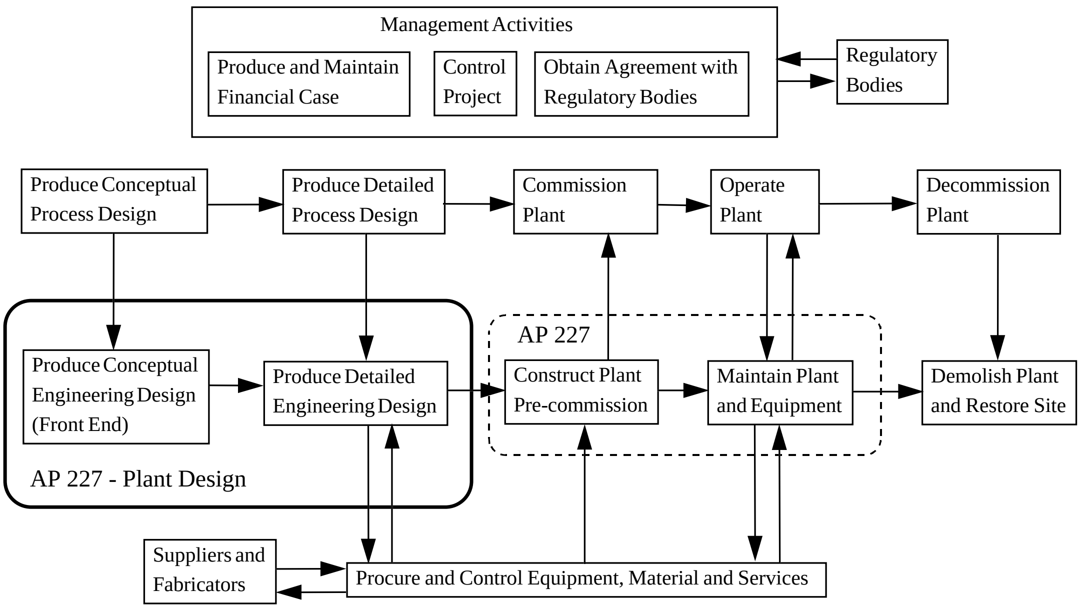

Figure 2 - Process plant life cycle activity coverage

NOTE 3 Design of piping systems includes the determination of the requirements of piping components, such as block valves, bypass valves, vents and drains, in-line instrumentation, and instrument taps, and their topological sequences. These piping component requirements and sequences are the starting point of the activities covered by this part of ISO 10303.

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

— the shape and spatial arrangement of plant items in plant systems within the process plant;

— explicit representation of the 3D shape of plant piping systems;

— explicit representation of the 3D external shape of plant piping system components and equipment. The representation may include envelope, outline and detailed representations as well as a parametric representation of the external shape.

— the functional configuration of the plant piping system and the relationship of the functional configuration to the planned physical piping system design;

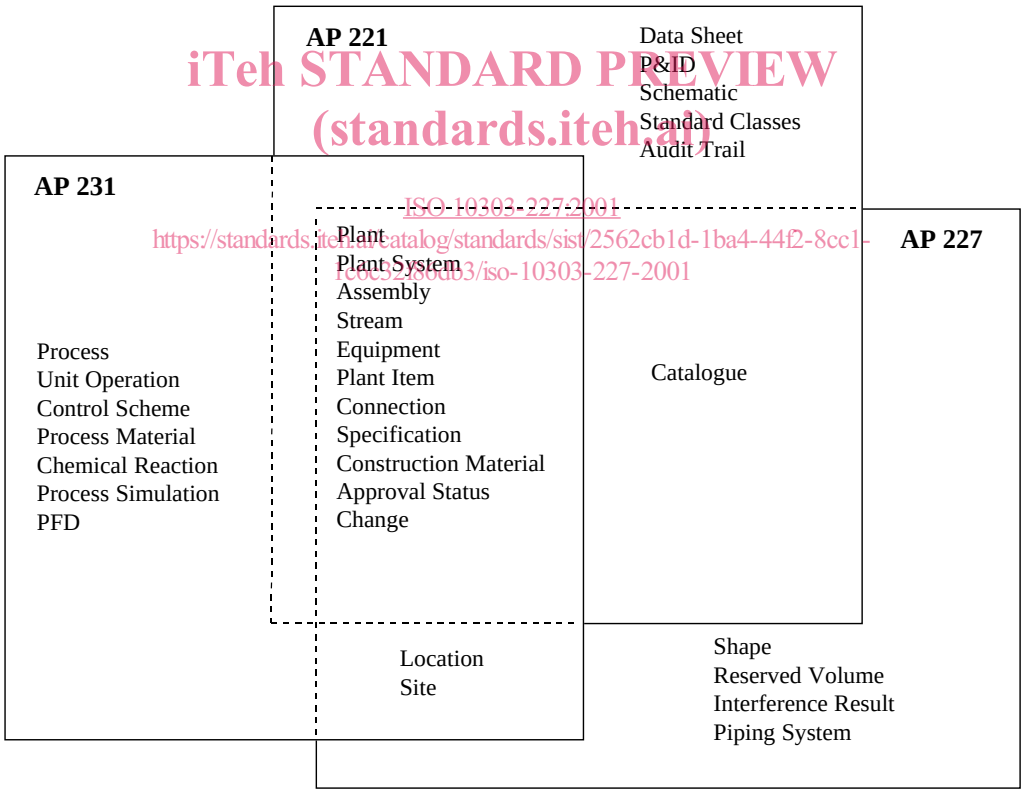

Figure 3 - Process plant AP coverage and overlaps

NOTE 4 The functional configuration overlaps the requirements specified in ISO 10303-221. Figure 3 illustrates areas of overlap between this part of ISO 10303 and ISO 10303-221 and ISO 10303-231.

NOTE 5 The functional configuration entails connectivity, sequencing, pipe size, pipe schedule, and flange class, and may include other information, such as equipment tag numbers and requirements to perform consistency checks between the functional and physical representations of the design.

— basic engineering data as needed for spatial layout and configuration of the plant piping system;

— references to functional requirements of the plant piping system, such as stream data and operational characteristics;

— references to or designation of functional characteristics of piping components and connected equipment as required for piping design;

— the identification, shape, location, and orientation of reserved areas, volumes, and space-occupying elements of a plant;

NOTE The connectivity and enumeration of non-piping systems (e.g., HVAC, electrical and structural), while provided for by the structure of this part of ISO 10303, is not the primary focus of this part.

— references to specifications, standards, guidelines, or regulations for the plant piping systems, components, or connected equipment that may specify physical characteristics of the system or component;

EXAMPLE 1 Physical characteristics include material and welding requirements.

EXAMPLE 2 References to standards include ISO 10303-221 [3] and ISO 13584 [13].

— the identification of catalogue information associated with a piping component;

— the identification of catalogues that contain piping component definitions;

— status of piping components and connected equipment and of their spatial arrangement;

NOTE Status labels are used by project management to monitor and control the execution of the project. Labels such as "preliminary", "in-work", and "released for design" are used to designate the degree of completeness or suitability for further action of the design or layout that the label is applied to.

— connections and connection requirements for piping components and equipment;

— definition of piping components in sufficient detail to support the acquisition of the components;

— change request approval, notification, and verification, tracking of differences between versions of piping system information, and tracking of changes to plant items and attributes of plant items;

NOTE Only the specific change information described in this part of ISO 10303 is in scope. The change process itself is not in scope.

