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

Part 1009:  
**Application module: Shape appearance  
and layers**

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

*Partie 1009: Module d'application: Apparence de forme et couches*



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## Foreword

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

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

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

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years with a view to deciding whether it should be confirmed for a further three years, revised to become an International Standard, or withdrawn. In the case of a confirmed ISO/PAS or ISO/TS, it is reviewed again after six years at which time it has to be either transposed into an International Standard or withdrawn.

Attention is drawn to the possibility that some of the elements of this part of ISO 10303 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 10303-1009 was prepared by Technical Committee ISO/TC 184, *Industrial automation system and integration*, Subcommittee SC 4, *Industrial data*.

ISO 10303 is organized as a series of parts, each published separately. The structure of ISO 10303 is described in ISO 10303-1.

Each part of ISO 10303 is a member of one of the following series: description methods, implementation methods, conformance testing methodology and framework, integrated generic resources, integrated applications resources, application protocols, abstract test suites, application interpreted constructs, and application modules. This part is a member of the application modules series.

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

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

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

## Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product, independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product 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, application modules, 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 module series.

This part of ISO 10303 specifies an application module for assignment of visual attributes and layers to shape models, geometric and topological elements.

A set of application modules can be combined to provide the capability to assign shape elements to layers and visual attributes, such as colours and curve fonts, to geometric and topological elements. For additional information, see Annex F of this technical specification of ISO 10303.



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

Part 1009:

## Application module: Shape appearance and layers

### 1 Scope

This part of ISO 10303 specifies the application module for the assignment of visual attributes and layers to shape models, geometric and topological elements.

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

- assignment of layers to shape items;
- assignment of visual attributes to shape items;
- assignment of colour to surfaces;
- assignment of visual attributes to curves belonging to surfaces.

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

- definition of views on which shape models, geometric elements or annotation are presented;
- specification of shape models.

### 2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10303. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 8824-1:1998, *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/TS 10303-1009:2001(E)**

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

ISO 10303-41:2000, *Industrial automation systems and integration — Product data representation and exchange — Part 41: Integrated generic resource: 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 10303-202:1996, *Industrial automation systems and integration — Product data representation and exchange — Part 202: Application protocol: Associative draughting*

ISO/TS 10303-1001:2001, *Industrial automation systems and integration — Product data representation and exchange — Part 1001: Application module: Appearance assignment*

## **3 Terms, definitions, and abbreviations**

### **3.1 Terms defined in ISO 10303-1**

For the purposes of this part of ISO 10303, the following terms defined in ISO 10303-1 apply:

- application;
- application object;
- application protocol;
- application reference model;
- data;
- information;
- integrated resource;
- product;
- product data;
- unit of functionality.

### **3.2 Terms defined in ISO 10303-202**

For the purposes of this part of ISO 10303, the following term defined in ISO 10303-202 applies:

- application interpreted construct.

### 3.3 Terms defined in ISO/TS 10303-1001

For the purposes of this part of ISO 10303, the following terms defined in ISO/TS 10303-1001 apply:

- application module;
- module interpreted model.

### 3.4 Abbreviations

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

AM	application module
ARM	application reference model
MIM	module interpreted model
UoF	unit of functionality
URL	uniform resource locator

## 4 Information requirements

This clause specifies the information requirements for the appearance assignment module. The information requirements are specified as a set of units of functionality and application objects. The information requirements are defined using the terminology of the subject area of this application module.

- A graphical representation of the information requirements is given in annex C.
- The mapping specification is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to application modules and protocols.

EXPRESS specification:

\*)  
 SCHEMA Shape\_appearance\_layer\_arm;  
 (\*

### 4.1 Units of functionality

This subclause specifies the units of functionality (UoF) for this part of ISO 10303 as well as any support elements needed for the application module definition. This part of ISO 10303 specifies the following unit of functionality:

- Shape\_appearance.

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This part of ISO 10303 uses the following units of functionality:

- Appearance assignment;
- Elemental\_topology;
- Foundation\_representation;
- General\_surface\_appearance;
- Layer\_assignment.

The units of functionality and a description of the functions that each UoF supports are given below. The application elements included in the UoFs are defined in clause 4.3.

### 4.1.1 Shape\_appearance

This UoF specifies information related to definition of visual attributes which may be assigned to shape items. In addition, it specifies contexts which allow for context-dependent assignment of visual attributes.

The following application entities are specified in the shape\_appearance UoF:

- Shape\_appearance;
- Shape\_appearance\_context;

### 4.1.2 Appearance\_assignment

This UoF is specified in the appearance assignment module. (See ISO/TS 10303-1001.) The following application entities from this UoF are referenced in the shape appearance layer application module:

- Appearance;
- Appearance\_context.

### 4.1.3 Elemental\_topology

This UoF is specified in the Elemental topology module. (See ISO/TS 10303-1005.) The inclusion of this UoF allows for assignment of visual attributes to topological elements. No application entities from this UoF are referenced by ARM types or entities specified in the shape\_appearance\_module.

### 4.1.4 Foundation\_representation

This UoF is specified in the foundation representation module. (See ISO/TS 10303-1006.) The following application entity from this UoF are referenced in the shape\_appearance\_layer module:

- Representation.

### 4.1.5 General\_surface\_appearance

This UoF is specified in the general surface appearance module. (See ISO/TS 10303-1007.) The following application entities from this UoF are referenced in the shape\_appearance\_layer module:

- Surface\_appearance\_wireframe;
- Surface\_colour.

### 4.1.6 Layer\_assignment

This UoF is specified in the layer assignment module. (See ISO/TS 10303-1008.) This UoF is described in ISO/TS 10303-1008. This UoF can provide additional capabilities, but it is not referenced by this application module.

## 4.2 Required AM ARMs

The following EXPRESS interface statements specify the elements imported from the ARMs of other application modules.

EXPRESS specification:

```
*)
USE FROM Appearance_assignment_arm; --ISO/TS 10303-1001
USE FROM Elemental_topology_arm; -- ISO/TS 10303-1005
USE FROM Foundation_representation_arm; -- ISO/TS 10303-1006
USE FROM General_surface_appearance_arm; -- ISO/TS 10303-1007
USE FROM Layer_assignment_arm; -- ISO/TS 10303-1008
(*
```

## 4.3 ARM type definitions

This subclause specifies the application types for the shape appearance and layers module. The application types and their definitions are given below.

### 4.3.1 shape\_appearance\_context\_select

A shape\_appearance\_context\_select defines possible contexts for the assignment of overriding visual attributes.

EXPRESS specification:

```
*)
TYPE shape_appearance_context_select = SELECT
    (Representation);
END_TYPE;
(*
```

### 4.3.2 shape\_appearance\_select

A shape\_appearance\_select defines the styles of visual attributes that can be assigned to shape models, geometric and topological elements.

EXPRESS specification:

```
*)  
TYPE shape_appearance_select = SELECT  
    (Surface_appearance_wireframe,  
     Surface_colour);  
END_TYPE;  
(*
```

## 4.4 ARM entity definitions

This subclause specifies the application entities for the shape appearance and layers module. Each application entity is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the entity. The application entities and their definitions are given below.

### 4.4.1 Shape\_appearance

A Shape\_appearance defines a visual style to be assigned to shape elements.

EXPRESS specification:

```
*)  
ENTITY Shape_appearance  
    SUBTYPE OF (Appearance);  
    appearance_style: shape_appearance_select;  
END_ENTITY;  
(*
```

Attribute definitions:

**appearance\_style:** specifies the visual style to be assigned to shape elements.

### 4.4.2 Shape\_appearance\_context

A Shape\_appearance\_context specifies a context for assignment of shape appearance.

EXPRESS specification:

```
*)  
ENTITY Shape_appearance_context  
    SUBTYPE OF (Appearance_context);  
    context_for_appearance: shape_appearance_context_select;  
END_ENTITY;  
(*
```

Attribute definitions:

**context\_for\_appearance:** specifies the context for assignment of shape\_appearance.

EXPRESS specification:

```
* )
END_SCHEMA;
(*
```

## 5 Module interpreted model

### 5.1 Mapping specification

This clause contains the mapping table that shows how each UoF and application element of this part of ISO 10303 (see clause 4) maps to one or several MIM resource constructs. The mapping table is organized in five columns. The contents of these five columns are:

Column 1) Application element: Name of an application element as it appears in the application entity definition. Application entity names are written in uppercase. Attribute names are listed after the application entity to which they belong and are written in lower case.

Column 2) MIM element: Name of an MIM element as it appears in the MIM, the term 'IDENTICAL MAPPING', or the term 'PATH'. MIM entities are written in lower case. Attribute names of MIM entities are referred to as <entity name>.<attribute name>. The mapping of an application element may result in several related MIM elements. Each of these MIM elements will require a line of its own in the table. The term 'IDENTICAL MAPPING' indicates that both application entities of an application assertion map to the same MIM element. The term 'PATH' indicates that the application assertion maps to the entire reference path.

Column 3) Source: For those MIM elements that are interpreted from the integrated resources, this is the number of the corresponding part of ISO 10303. For those MIM elements that are created for the purpose of this part of ISO 10303, this is the number of this part.

Column 4) Rules: One or more numbers may be given which refer to rules that apply to the current MIM element or reference path. For rules that are derived from relationships between application entities, the same rule is referred to by the mapping entries of all the involved MIM elements. The expanded names of the rules are listed after the table.

Column 5) Reference path: To describe fully the mapping of an application entity, it may be necessary to specify a reference path through several related MIM elements. The reference path column documents the role of a MIM element relative to the MIM element in the row succeeding it. Two or more such related MIM elements define the interpretation of the integrated resources that satisfies the requirement specified by the application entity. For each MIM element that has been created for use within this part of ISO 10303, a reference path up to its supertype from an integrated resource is specified.

For the expression of reference paths and the relationships between MIM elements, the following notational conventions apply:

- a) [] : multiple MIM elements or sections of the reference path are required to satisfy an information requirement;

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- b) () : multiple MIM elements or sections of the reference path are identified as alternatives within the mapping to satisfy an information requirement;
- c) {} : enclosed section constrains the reference path to satisfy an information requirement;
- d) -> : attribute references the entity or select type given in the following row;
- e) <- : entity or select type is referenced by the attribute in the following row;
- f) [i] : attribute is an aggregation of which a single member is given in the following row;
- g) [n] : attribute is an aggregation of which member n is given in the following row;
- h) => : entity is a supertype of the entity given in the following row;
- i) <= : entity is a subtype of the entity given in the following row;
- j) = : the string, select or enumeration type is constrained to a choice or value;
- k) \ : the line continuation for strings that wrap.

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**Table 1 - Mapping table for Shape\_appearance UoF**

Application element	MIM element	Source	Rules	Reference path
SHAPE_APPEARANCE	(surface_style_usage)	1007		
appearance_style	PATH			surface_style_usage<- presentation_style_assignment.styles[i] presentation_style_assignment presentation_style_assignment.styles[i]-> presentation_style_select=surface_style_usage surface_style_usage
SHAPE_APPEARANCE_- CONTEXT	representation	1006		
context_for_appearance #1 If representation	PATH			representation<- presentation_style_by_context.style_context presentation_style_by_context presentation_style_by_context.style_context-> style_context_select=representation representation

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## 5.2 MIM EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources, application interpreted constructs or application modules and contains the types, entity specializations, rules, and functions that are specific to this part of ISO 10303. This clause also specifies modifications to the textual material for constructs that are imported from the integrated resources. The definitions and EXPRESS provided in the integrated resources or application interpreted constructs for constructs used in the MIM may include select list items and subtypes which are not imported into the MIM. Requirements stated in the integrated resources or application interpreted constructs which refer to such items and subtypes apply exclusively to those items which are imported into the MIM.

### EXPRESS specification:

```

*)
SCHEMA Shape_appearance_layer_mim;
USE FROM Appearance_assignment_mim;           -- ISO/TS 10303-1001
USE FROM Elemental_topology_mim;             -- ISO/TS 10303-1005
USE FROM Foundation_representation_mim;      -- ISO/TS 10303-1006
USE FROM General_surface_appearance_mim;    -- ISO/TS 10303-1007
USE FROM Layer_assignment_mim;              -- ISO/TS 10303-1008
(*

```

NOTE 1 See annex C for a graphical presentation of this schema using the EXPRESS-G notation.

NOTE 2 The schemas referenced above can be found in the following parts of ISO 10303:

Appearance_assignment_mim	ISO/TS 10303-1001
Elemental_topology_mim	ISO/TS 10303-1005
Foundation_representation_mim	ISO/TS 10303-1006
General_surface_appearance_mim	ISO/TS 10303-1007
Layer_assignment_mim	ISO/TS 10303-1008

### EXPRESS specification:

```

*)
END_SCHEMA;
(*

```

**Annex A**  
(normative)

**MIM short names**

Entity names in this part of ISO 10303 have been defined in other parts of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

NOTE The EXPRESS entity names are available from Internet:

<<http://www.mel.nist.gov/div826/subject/apde/snr/>>.

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## Annex B (normative)

### Information object registration

#### B.1 Document identification

To provide for unambiguous identification of an information object in an open system, the object identifier

{ iso standard 10303 part(1009) version(1) }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

#### B.2 Schema identification

##### B.2.1 shape\_appearance\_layer\_arm schema identification

To provide for unambiguous identification of the schema specifications given in this application module in an open information system, the object identifiers are assigned as follows:

{ iso standard 10303 part(1009) version(1) object(1) shape-appearance-layer-arm-schema(1) }

is assigned to the shape\_appearance\_layer\_arm schema. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

##### B.2.2 shape\_appearance\_layer\_mim schema identification

To provide for unambiguous identification of the schema specifications given in this application module in an open information system, the object identifiers are assigned as follows:

{ iso standard 10303 part(1009) version(1) object(1) shape-appearance-layer-mim-schema(2) }

is assigned to the shape\_appearance\_layer\_mim schema short form schema (see 5.2). The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

**Annex C**  
(informative)

**ARM EXPRESS-G**

The following diagrams correspond to the ARM EXPRESS listing given in clause 4. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex D of ISO 10303-11.

NOTE The inter-page referencing is to the diagram number and not the figure number.

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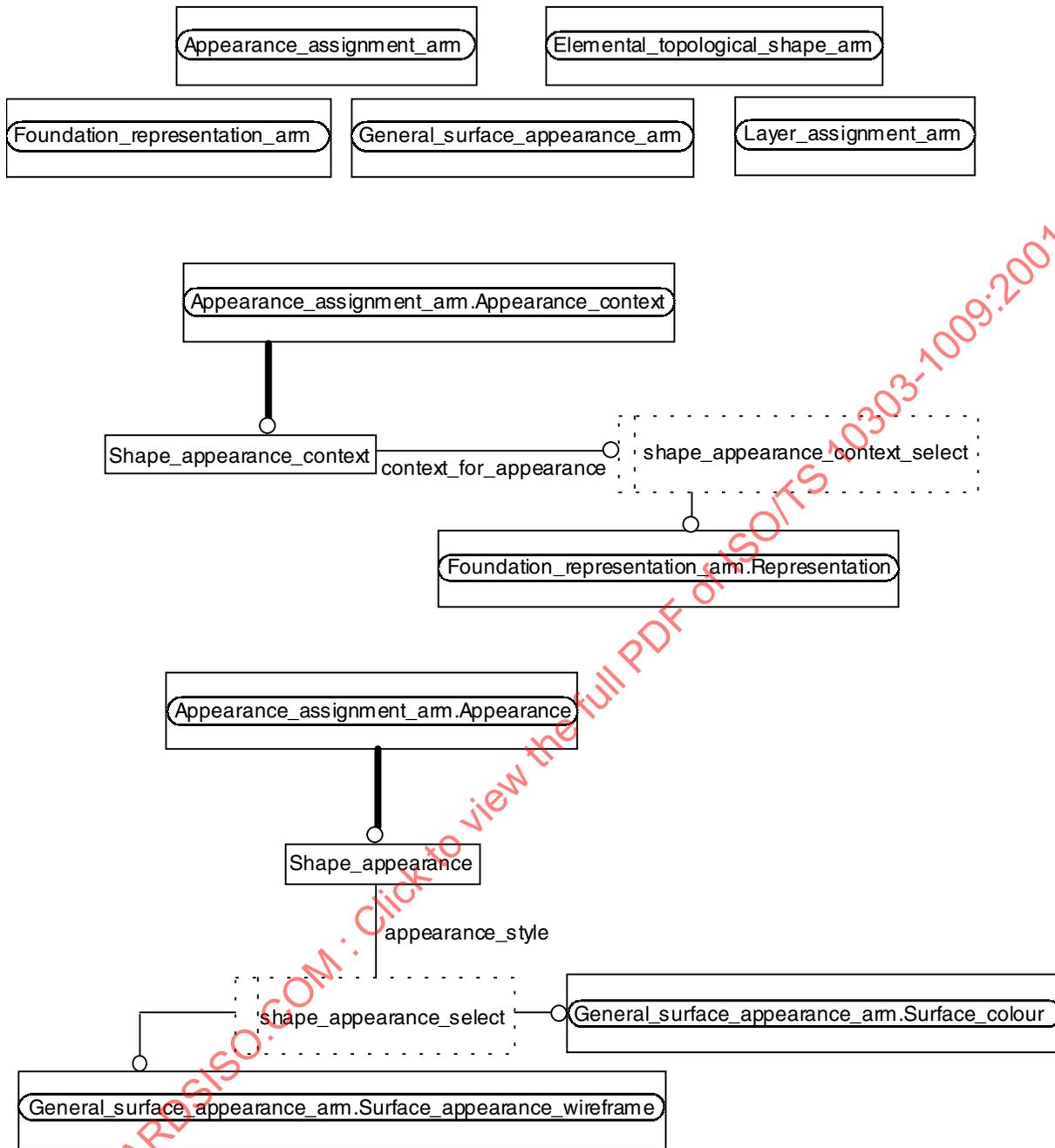


Figure C.1 - ARM EXPRESS-G diagram 1 of 1

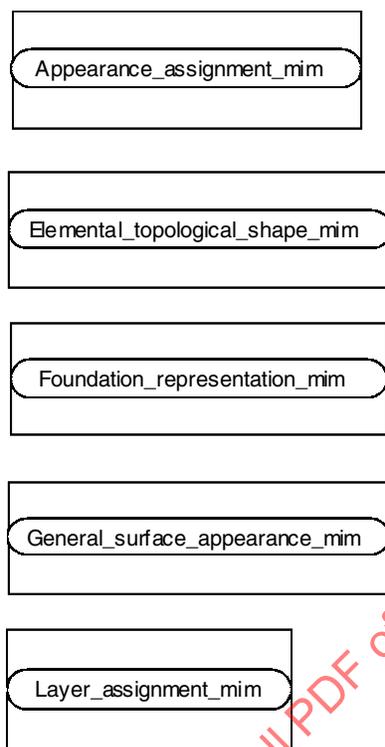
**Annex D**  
(informative)

**MIM EXPRESS-G**

The following diagrams correspond to the MIM EXPRESS expanded listing. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex D of ISO 10303-11.

NOTE The inter-page referencing is to the diagram number and not the figure number.

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**Figure D.1 - ARM EXPRESS-G diagram 1 of 1**

**Annex E**  
(informative)

**Computer interpretable listings**

This annex references a listing of the EXPRESS entity names and corresponding short names as specified in this part of ISO 10303. It also provides a listing of each EXPRESS schema specified in this part of ISO 10303 without comments or other explanatory text. These listings are available in computer-interpretable form and can be found at the following URLs:

Short names: <http://www.mel.nist.gov/div826/subject/apde/snr>

EXPRESS: <http://www.mel.nist.gov/step/parts/part1009/TS/>

If there is difficulty accessing these sites, contact ISO Central Secretariat or contact the ISO TC184/SC4 Secretariat directly at: [sc4sec@cme.nist.gov](mailto:sc4sec@cme.nist.gov).

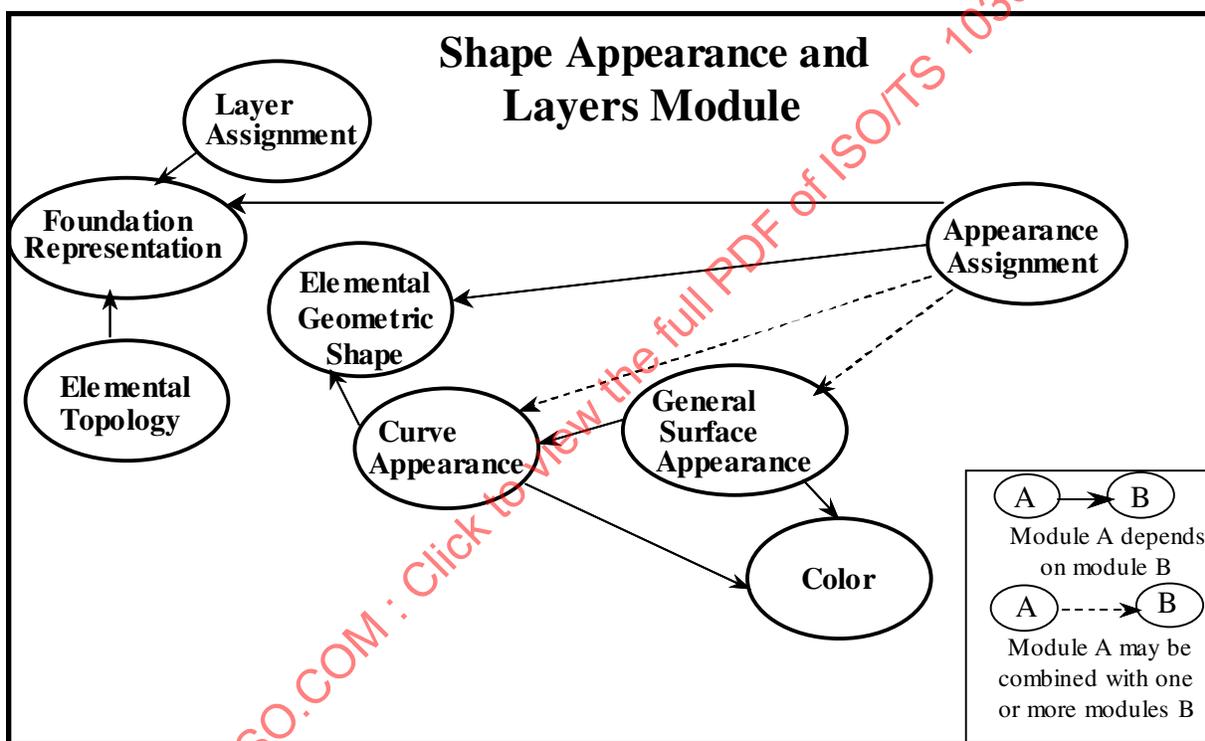
NOTE The information provided in computer-interpretable form at the above URLs is informative. The information that is contained in the body of this part of ISO 10303 is normative.

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**Annex F**  
(informative)

**Technical discussions**

The purpose of this application module is to bring together a set of application modules to provide the capability to assign shape elements to layers and visual attributes, such as colours and curve fonts, to geometric and topological elements. Figure E.1 shows the other application modules, and the dependencies between them, necessary to provide the shape appearance and layers capability. CAD vendors have developed test cases to assess their implementations of this application module.



**Figure F.1 - Shape\_appearance\_layer application module dependencies**

As depicted in figure F.1, the scope addressed in the Shape appearance layer application module requires eight other application modules. Appearance assignment, Foundation representation, General surface appearance, Elemental topological shape and Layer assignment are interfaced directly (see the USE FROM statements in clause 5). Color, Elemental geometric shape and Curve appearance are included by virtue of the fact that the EXPRESS USE FROM interface declaration treats data types declared within or USE'd by the foreign schema as if declared locally.

The Shape appearance and layers application module can be combined with any other application module, application interpreted construct or application protocol whose EXPRESS interpreted schema includes subtypes of entities **geometric\_representation\_item** or **topological\_representation\_item**. This is illustrated in figure F.2.