INTERNATIONAL STANDARD

ISO 10303-518

First edition
2002-08-15

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

Part 518: Application interpreted construct: Mechanical design shaded presentation

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

Partie 518: Construction interprétée d'application: Conception mécanique en présentation ombrée

Reference number
ISO 10303-518:2002(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Figures

Tables

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.

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

ISO 10303–518 was prepared by Technical Committee ISO/TC 184, *Industrial automation systems and integration*, Subcommittee SC 4, *Industrial data*.

This International Standard is organised as a series of parts, each published separately. The structure of this International Standard is described in ISO 10303-1.

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

A complete list of parts of ISO 10303 is available from 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 and D are for information only.

Introduction

ISO 10303 is an International Standard for the computer-interpretable representation of product information and for the 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 interpreted construct series. An application interpreted construct (AIC) provides a logical grouping of interpreted constructs that supports a specific functionality for the usage of product data across multiple application contexts. An interpreted construct is a common interpretation of the integrated resources that supports shared information requirements among application protocols.

This document specifies the application interpreted construct for the description of advanced visual presentations of the shape of mechanical design models. Shape is projected into a plane display area. The projections themselves are not represented, however the shape and corresponding projection algorithms are given. Basic presentation attributes are included, such as line font and colour, and more advanced functionality, such as light sources and surface reflectance. The latter are used to provide a more realistic presentation of properties. All presentation attributes may be applied to parts or all of wireframe, surface, and solid models. Association of attributes with topological items is included to provide for the styling of high level shape constructs. The representation of annotation, such as text and symbols, is not specified.

Industrial automation systems and integration — Product data representation and exchange — Part 518: Application interpreted construct: Mechanical design shaded presentation

1 Scope

This part of ISO 10303 specifies the interpretation of the integrated resources to satisfy requirements for the description of the visual presentation of shaded shape. Basic presentation attributes, such as colour, can be associated with points, curves, surfaces, and topological constructs. Advanced visualization properties, such as surface reflectance and transparency, may be applied to curves and surfaces. The projection algorithm includes light sources and hidden line and hidden surface removal. The description of annotation is not included.

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

— the visual presentation of mechanical design shape representations;

— the assignment of visual presentation attributes to geometric and topological items;

— algorithms for the projection of 3D shapes onto planes;

— the location of shape projections within a window;

— multiple views within one window;

— the background colour of a window;

— hidden line and hidden surface removal;

— light sources;

— point, curve, and surface colour;

— point font;

— curve font;

— curve styles dependent on the role of the curves in the definition of a surface;

EXAMPLE Boundary curves and grid curves play different roles in the definition of a surface.

— shaded and unshaded surface colour;

— surface characteristics such as transparency and reflectance;

— pre-defined colours;

— pre-defined curve styles.

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

— the presentation of annotation, i.e. text and symbols;

— the assignment of geometric items to layers;

— multiple windows;

— representation of products.

NOTE - The scope of this part of ISO 10303 is closely related to ISO 10303-517. This part extends the scope of ISO 10303-517 to also include hidden line and hidden surface representations, light sources, and curve and surface rendering.

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) – Part 1: Specification of basic notation*

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

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

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

ISO 10303–42:1994, *Industrial automation systems and integration – Product data representation and exchange – Part 42: Integrated generic 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*

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*

NOTE - ISO 10303-202 is referenced normatively solely for the definition of the term AIC.

3 Terms 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:

— abstract test suite (ATS);

— application;

— application context;

— application protocol (AP);

— data;

— data exchange;

— generic resource;

— implementation method;

— information;

— integrated resource;

— interpretation;

— model;

— presentation;

— product;

— product data;

— structure.

3.2 Terms defined in ISO 10303–42

For the purposes of this part of ISO 10303, the following terms defined in ISO 10303-42 apply:

— curve;

— surface.

3.3 Terms defined in ISO 10303–46

For the purposes of this part of ISO 10303, the following terms defined in ISO 10303-46 apply:

— annotation;

— layer;

— picture;

— presentation information;

— RGB;

— realistic presentation of properties;

— symbol;

— synthetic camera model;

— visualization.

3.4 Terms defined in ISO 10303–202

For the purposes of this part of ISO 10303, the following terms defined in ISO 10303-202 apply:

— application interpreted construct (AIC);

— externally defined;

— pre-defined.

3.5 Abbreviations

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

AIC	application interpreted construct
AP	application protocol
ATS	abstract test suite
RGB	red, green, blue colour space

4 EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources and contains the types, entity specializations, and functions that are specific to this part of ISO 10303.

NOTE 1 - There may be subtypes and items of select lists that appear in the integrated resources that are not imported into the AIC. Constructs are eliminated from the subtype tree or select list through the use of the implicit interface rules of ISO 10303-11. References to eliminated constructs are outside the scope of the AIC. In some cases, all items of the select list are eliminated. Because AICs are intended to be implemented in the context of an application protocol, the items of the select list will be defined by the scope of the application protocol.

EXPRESS specification:

```
*)
SCHEMA aic_mechanical_design_shaded_presentation;

    USE FROM geometry_schema                          -- ISO 10303-42
    (axis2_placement_2d);

    USE FROM measure_schema                           -- ISO 10303-41
    (positive_ratio_measure);

    USE FROM presentation_appearance_schema           -- ISO 10303-46
     (curve_style,
      curve_style_font,
      curve_style_font_pattern,
      curve_style_rendering,
      draughting_pre_defined_curve_font,
      fill_area_style_colour,
      invisibility,
      marker_type,
      over_riding_styled_item,
      point_style,
      presentation_style_by_context,
      styled_item,
      surface_rendering_properties,
      surface_side_style,
      surface_style_boundary,
      surface_style_control_grid,
```

```
    surface_style_fill_area,
    surface_style_parameter_line,
    surface_style_reflectance_ambient,
    surface_style_reflectance_ambient_diffuse,
    surface_style_reflectance_ambient_diffuse_specular,
    surface_style_rendering,
    surface_style_rendering_with_properties,
    surface_style_segmentation_curve,
    surface_style_silhouette,
    surface_style_transparent,
    surface_style_usage,
    u_direction_count,
    v_direction_count);

  REFERENCE FROM presentation_organization_schema   -- ISO 10303-46
   (aspect_ratio);

  USE FROM presentation_organization_schema         -- ISO 10303-46
   (background_colour,
    camera_image_3d_with_scale,
    camera_model_d3,
    camera_model_d3_with_hlhsr,
    camera_model_with_light_sources,
    camera_usage,
    light_source_ambient,
    light_source_directional,
    light_source_positional,
    light_source_spot,
    presentation_area,
    presentation_representation,
    presentation_size,
    presentation_view);

  USE FROM presentation_resource_schema             -- ISO 10303-46
   (colour_rgb,
    draughting_pre_defined_colour,
    planar_box,
    planar_extent);

  USE FROM representation_schema                    -- ISO 10303-43
   (mapped_item,
    representation);

(*
```

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

`geometry_schema`	ISO 10303-42
`measure_schema`	ISO 10303-41
`presentation_appearance_schema`	ISO 10303-46
`presentation_organization_schema`	ISO 10303-46
`presentation_resource_schema`	ISO 10303-46
`representation_schema`	ISO 10303-43

4.1 Fundamental concepts and assumptions

This application interpreted construct provides a consistent set of entities for the representation of pictures of mechanical products that are in the design stage. All pictures shall be presented in the same window on a display. A picture may include one or several views of a product shape. Using this part of ISO 10303 only the association between a product shape and its projection algorithms is represented, not the projections themselves.

The structure for the management of pictures is implemented using entities **mechanical_design_shaded_presentation_area**, **presentation_view**, and **mechanical_design_shaded_presentation_representation**. The relationships between these entities are represented using the **mapped_item** and **representation_map** entities. A **mechanical_design_shaded_presentation_representation** is a subtype of **presentation_area**. This subtype has been created for the purpose of this part of ISO 10303. All the contents of a window, that is the views on one or several product shapes, shall be included in one **mechanical_design_shaded_presentation_area**.

A view is represented by a **presentation_view**. The view shall contain entity **camera_image_3d_with_scale**, which for the purpose of this part of ISO 10303 has been created as a subtype of **camera_image** and, thus, of **mapped_item**. Via **camera_usage** this entity references **camera_model_d3** as its **mapping_origin**, which has the information that is necessary to compute the projection of a shape. To allow more realistic presentations of a product shape, hidden line and hidden surface removal, as well as light sources, can be specified using the subtypes of **camera_model_d3**, **camera_model_d3_with_hlhsr**, and **camera_model_with_light_sources**.

The product shape itself is linked into the presentation hierarchy by **mechanical_design_shaded_presentation_representation**, which has also been created for the purpose of this part of ISO 10303. This entity shall be referenced as the **mapped_representation** of a **camera_image_3d_with_scale**. All **items** of a **mechanical_design_shaded_presentation_representation** shall be either **styled_item**s that describe shape, **camera_model_d3**s, or **mapped_item**s. **Mapped_item**s shall be mappings of either **shape_representation**s or of other **mechanical_design_shaded_presentation_representation**s. The **item** of a **styled_item** may either reference directly a **geometric_representation_item** or a **topological_representation_item**, or indirectly via a **mapped_item** that is the mapping of a **shape_representation**.

The appearance of product shape may be specified using styles for **point**s, **curve**s, and **surface**s. Styles may also be assigned to topological elements of product shape. A style assignment is made by instantiating a **styled_item**, which refers to a **representation_item** together with its **presentation_style_assignment**. The **representation_item** may be a **mapped_item** that references a **shape_representation**

as its **mapped_representation**. The **styled_item**s are collected into a **mechanical_design_shaded_-presentation_representation**, as mentioned above.

The **presentation_style_assignment** of a **styled_item** affects the appearance of the referenced **representation_item** as well as the appearance of all **representation_item**s referenced directly or indirectly by that item. Only those **representation_item**s are affected that are not already styled. This means styling a styled **representation_item** has no effect. Styling a partially styled **representation_item** affects only the appearance of the unstyled parts. Styling an unstyled **representation_item** affects the appearance of the whole item. Only styled **representation_item**s may be presented. Whether they are actually presented depends also on other facts, like **invisibility**. This part of ISO 10303 does not make any statement about the effect if style conflicts occur.

EXAMPLE A style conflict occurs, for example, when a **representation_item** is used by several **styled_-item**s.

A **presentation_style_assignment** is used to assign styles to a **representation_item** independently from any presentation context. A subtype of **presentation_style_assignment**, the **presentation_style_by_-context**, allows the assignment of style for a specific presentation context. A presentation context can be any **representation** or **representation_item**.

Point_styles allow the specification of the marker symbol, marker size, and colour to be used for presenting points.

Curve_styles allow the specification of curve fonts, curve width, and colour. The appearance of curve ends and corners, and of patterns for filling visible curve segments is not distinguished. A curve font specifies whether a curve shall be drawn using solid, dashed, or dotted lines. The specification of arbitrary patterns for curve fonts and the usage of externally defined curve fonts are not included. Curve fonts may be pre–defined. The entities used for the definition of curve fonts are **draughting_pre_defined_curve_-font** and **curve_style_font**. The curve width shall be specified as a measure value. The **curve_style_-rendering** controls the rendering of curves on a surface and is described together with surface styles below.

Surface styles provide the resources to specify the visual appearance of surfaces. Separate surface styles may be applied to each side of a surface using entities **surface_style_usage** and **surface_side_style**. A surface side style may be any combination of fill area style, boundary style, silhouette style, segmentation curve style, control grid style, parameter line style, or rendering style.

A fill area style specifies a style for presenting visible surfaces by mapping a coloured fill area upon them.

A boundary style specifies a curve style for presenting the boundary curves of a surface. If no boundary style is specified, the boundary curves shall not be presented.

A silhouette style specifies a curve style for presenting the silhouette curves of a surface. If no silhouette style is specified, silhouette curves shall not be presented.

A segmentation curve style specifies a curve style for presenting the segmentation curves of a surface. This style affects only surfaces which are divided into segments, such as B–spline surfaces. If no segmentation curve style is specified, segmentation curves shall not be presented.

A control grid style specifies a curve style for presenting the mesh of control points which are used for the definition of a surface. This style affects only surfaces which are defined over a mesh of control points, such as B–spline surfaces. If no control grid style is specified, the control grid shall not be presented.

A parameter line style specifies a curve style for presenting iso–parameter lines of a surface. The number of parameter lines in each parameter direction has to be specified for this style. If no parameter line style is specified, the parameter lines shall not be presented.

The entities defining these surface styles are **surface_fill_area**, **surface_style_boundary**, **surface_style_silhouette**, **surface_style_segmentation_curve**, **surface_style_control_grid**, and **surface_style_parameter_line**.

The entities **curve_style_rendering** and **surface_rendering_properties** specify the rendering method and properties for curves on a surface. A rendering style specifies the method which shall be used for rendering the surface. If this style is specified, surface rendering using reflectance calculations is performed for presenting the surface. For this style, a colour shall be specified for the surface. Additional rendering properties including transparency and ambient, diffuse, and specular reflectance coefficients can optionally be specified. The entities for rendering styles are **surface_style_rendering**, **surface_style_rendering_with_properties**, **surface_style_transparent**, **surface_style_reflectance_ambient**, **surface_style_reflectance_ambient_diffuse**, and **surface_style_reflectance_ambient_diffuse_specular**. Pre–defined surface styles are not included.

Colours may be specified based on the RGB colour model using entity **colour_rgb** or by **draughting_pre_defined_colour**.

This part of ISO 10303 does not include constructs for the representation of annotation.

The following entities are intended to be independently instantiated in the application protocol schemas that use this AIC:

– camera_image_3d_with_scale;

– draughting_pre_defined_colour;

– draughting_pre_defined_curve_font;

– invisibility;

– mapped_item;

– mechanical_design_shaded_presentation_area;

– mechanical_design_shaded_presentation_representation;

– over_riding_styled_item;

– presentation_style_by_context.

4.2 aic_mechanical_design_shaded_presentation entity definitions

4.2.1 mechanical_design_shaded_presentation_area

A **mechanical_design_shaded_presentation_area** contains information that is needed to determine the projection from some mechanical design model to a corresponding picture on a screen. The design model may be represented by any type of shape, such as a wireframe, surface, or solid. A **mechanical_design_-shaded_presentation_area** is a **presentation_area** that is restricted to a certain presentation hierarchy. A **mechanical_design_shaded_presentation_area** shall be a single–window presentation of a product; no other **presentation_area**s shall be included in a **mechanical_design_shaded_presentation_area**. The model that is presented shall be a **mechanical_design_shaded_presentation_representation**. The camera model used may provide light sources and hidden line and hidden surface removal.

EXPRESS specification:

```
*)
  ENTITY mechanical_design_shaded_presentation_area
    SUBTYPE OF (presentation_area);
  WHERE
  WR1 : (* only presentation_views or axis2_placements in
           mechanical_design_shaded_presentation_area *)
        SIZEOF (QUERY (it1 <* SELF.items |
        NOT (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.AXIS2_PLACEMENT'
        IN TYPEOF (it1))
        OR
        (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF (it1)) AND
        ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.PRESENTATION_VIEW'
        IN TYPEOF
        (it1\mapped_item.mapping_source.mapped_representation)))))) = 0;
  WR2 : (* only mechanical_design_shaded_presentation_representation
           via camera_image_3d_with_scale or axis2_placements in
           presentation_views *)
        SIZEOF (QUERY (pv <* QUERY (mi1 <* QUERY (it1 <* SELF.items |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF (it1)) |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.PRESENTATION_VIEW'
        IN TYPEOF
        (mi1\mapped_item.mapping_source.mapped_representation)) |
        (* search in all presentation_views for axis2_placements and
           mapped_items and for the subtype of mapped_item,
```

```
         camera_image_3d_with_scale; the latter shall reference
         a mechanical_design_geometric_presentation_representation;
         the supertype mapped_item shall reference presentation_view. *)
      NOT (SIZEOF(QUERY(it2 <* pv\mapped_item.mapping_source.
      mapped_representation.items |
      NOT (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.AXIS2_PLACEMENT'
      IN TYPEOF(it2))
      OR
      (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM'
      IN TYPEOF(it2)) AND NOT
      ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'CAMERA_IMAGE_3D_WITH_SCALE' IN TYPEOF(it2))) AND NOT (
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.PRESENTATION_VIEW'
      IN TYPEOF
      (it2\mapped_item.mapping_source.mapped_representation)))
      OR
      (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'CAMERA_IMAGE_3D_WITH_SCALE' IN TYPEOF(it2))
      AND NOT (
      ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'MECHANICAL_DESIGN_SHADED_PRESENTATION_REPRESENTATION'
      IN TYPEOF (it2\mapped_item.mapping_source.mapped_representation) ))
      ))) = 0))) = 0;
WR3:  (* Presentation_size shall be a positive rectangle for area and set.
         Check for this presentation_area subtype first. *)
      (SIZEOF (QUERY(ps <* USEDIN (SELF,
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'PRESENTATION_SIZE.UNIT') |
      NOT ((ps.size\planar_extent.size_in_x > 0)
      AND (ps.size\planar_extent.size_in_y > 0)) )) = 0)
      AND
      (* check secondly for presentation_set, via area_in_set *)
      (SIZEOF (QUERY(pset <* QUERY(ais <*
      USEDIN (SELF, 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'AREA_IN_SET.AREA')
      | 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'PRESENTATION_SET' IN TYPEOF (ais.in_set)) |
      (* after having collected all presentation_set, check their sizes *)
      SIZEOF (QUERY(psize <* USEDIN(pset,
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'PRESENTATION_SIZE.UNIT')
      | NOT ((psize.size\planar_extent.size_in_x > 0)
      AND (psize.size\planar_extent.size_in_y > 0)) )) = 0)) = 0);
WR4:  (* Drawing space shall be defined in 2D.
         Check for this presentation_area subtype first. *)
      (SIZEOF(QUERY( psize <* USEDIN (SELF,
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'PRESENTATION_SIZE.UNIT')
      | 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
      'AXIS2_PLACEMENT_2D'
      IN TYPEOF (psize.size.placement))) = 1)
      AND
```

```
        (* check secondly for presentation_set, via area_in_set *)
        (SIZEOF (QUERY(pset <* QUERY(ais <*
        USEDIN (SELF, 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
        'AREA_IN_SET.AREA')
        | 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
        'PRESENTATION_SET' IN TYPEOF (ais.in_set)) |
        (* after having collected all presentation_set, check their
           dimension *)
        SIZEOF (QUERY(psize <* USEDIN(pset,
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
        'PRESENTATION_SIZE.UNIT')
        | NOT ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
        'AXIS2_PLACEMENT_2D'
        IN TYPEOF (psize.size.placement)) )) = 0)) = 0);
  WR5 : (* valid types of camera_models
           get for all presentation_areas their presentation_views *)
        SIZEOF (QUERY (pv <* QUERY (mi1 <* QUERY (it1 <* SELF.items |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM'
        IN TYPEOF (it1)) |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.PRESENTATION_VIEW'
        IN TYPEOF
        (mi1\mapped_item.mapping_source.mapped_representation)) |
        (* search in all presentation_views for
           mapped_items and for the subtype of mapped_item,
           camera_image_3d_with_scale; the latter shall reference
           a camera_usage that shall have as its mapping_origin either
           camera_model_d3, camera_model_d3_with_hlhsr, or
           camera_model_with_light_sources. *)
        NOT (SIZEOF(QUERY(ci <* pv\mapped_item.mapping_source.
        mapped_representation.items |
        ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
         'CAMERA_IMAGE_3D_WITH_SCALE' IN TYPEOF(ci))
        AND
        (SIZEOF(['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CAMERA_MODEL_D3',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CAMERA_MODEL_D3_WITH_HLHSR',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CAMERA_MODEL_WITH_LIGHT_SOURCES'] * TYPEOF
        (ci\mapped_item.mapping_source.mapping_origin))
        = 1))) = 0))) = 0;
  END_ENTITY; (* mechanical_design_shaded_presentation_area *)
(*
```

Formal propositions:

WR1: The **items** of a **mechanical_design_shaded_presentation_area** shall only be **axis2_placement**s or **mapped_item**s. In the latter case the **mapped_representation** of the **representation_map** that is the **mapping_source** of such a **mapped_item** shall be a **presentation_view**.

WR2: The items of a **presentation_view** shall only be **axis2_placements** or **mapped_items**. In the latter case a **mapped_item** may be of type **camera_image_3d_with_scale** with the **mapped_representation** of the **representation_map** that is the **mapping_source** of such a **mapped_item** being a **mechanical_design_shaded_presentation_representation**. If the **mapped_item** is not a **camera_image_3d_with_scale**, the **mapped_representation** of the **representation_map** that is the **mapping_source** of this **mapped_item** shall be a different **presentation_view**.

NOTE - If a user of this part of ISO 10303 includes in addition to **camera_image_3d_with_scale** other subtypes of **mapped_item** into a schema, additional rules may be required to exclude these subtypes to be instantiated in a **presentation_view**. This part does not hinder the instantiation of subtypes of **mapped_item** that are not specified in this part.

WR3: The rectangular size of the **mechanical_design_shaded_presentation_area** shall be specified by positive values. The same shall be valid for the **presentation_set** that this area is enclosed in.

WR4: The drawing space of a **mechanical_design_shaded_presentation_area** shall be specified in a 2D co-ordinate system.

WR5: The **mapping_origin** of a **camera_usage** that is the **mapping_source** of a **camera_image_3d_with_scale** within a **presentation_view** shall be either a **camera_model_d3**, a **camera_model_d3_with_hlhsr**, or a **camera_model_with_light_sources**.

4.2.2 mechanical_design_shaded_presentation_representation

A **mechanical_design_shaded_presentation_representation** specifies the shape and optionally related presentation styles that shall be viewed in a **mechanical_design_shaded_presentation_area**. The entity is a subtype of **representation**. All **items** of a **mechanical_design_shaded_presentation_representation** shall be either **styled_item**s that describe shape, **camera_model_d3**s, or **mapped_item**s. **Mapped_item**s shall be mappings of either **shape_representation**s or of other **mechanical_design_shaded_presentation_representation**s. The **item** of a **styled_item** may either reference directly a **geometric_representation_item** or a **topological_representation_item**, or indirectly via a **mapped_item** that is the mapping of a **shape_representation**. The use of styles and style attributes for points, curves, and surfaces is restricted.

EXPRESS specification:

```
*)
ENTITY mechanical_design_shaded_presentation_representation
   SUBTYPE OF (representation);
WHERE
  WR1:  SIZEOF(QUERY(it <* SELF.items |
        NOT (SIZEOF(
        ['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.AXIS2_PLACEMENT',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CAMERA_MODEL_D3']
        * TYPEOF(it)) = 1))) = 0;
  WR2:  (* for all mapped_items check that only
```

```
          shape_representations and
          mechanical_design_shaded_presentation_representations
          are referenced *)
       SIZEOF(QUERY(mi <* QUERY(it <* SELF.items |
       ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM'
       IN TYPEOF(it))) | NOT (SIZEOF(
       ['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
       'SHAPE_REPRESENTATION',
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
       'MECHANICAL_DESIGN_SHADED_PRESENTATION_REPRESENTATION']
       * TYPEOF(mi\mapped_item.mapping_source.mapped_representation))
       = 1))) = 0;
 WR3:  (* for all styled_item.item check that in case they are
          mapped_items that they are shape_representations *)
       SIZEOF(QUERY(smi <* QUERY(si <* QUERY(it <* SELF.items |
       ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
       IN TYPEOF(it))) |
       ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MAPPED_ITEM'
       IN TYPEOF(si\styled_item.item))) | NOT (
       ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.' +
       'SHAPE_REPRESENTATION' IN TYPEOF (smi\styled_item.
       item\mapped_item.mapping_source.mapped_representation))) )) = 0;
 WR4 : (* for all styled_items get their styles via
          presentation_style_assignment.styles and check for valid
          style types *)
       SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
       IN TYPEOF (it)) |
       NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
       NOT (SIZEOF (QUERY (pss <* psa.styles |
       NOT (SIZEOF (
       ['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.POINT_STYLE',
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE',
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE']
       *  TYPEOF (pss)) = 1))) = 0))) = 0))) = 0;
 WR5 : (* for all styled_items get those assigned styles that
          are presentation_style_by_contexts and ensure that
          these reference only representation_items and
          representations as valid contexts *)
       SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
       IN TYPEOF (it)) |
       NOT (SIZEOF (QUERY (psbc <* QUERY (psa <* si\styled_item.styles |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
       'PRESENTATION_STYLE_BY_CONTEXT' IN TYPEOF (psa))  |
       NOT (SIZEOF (
       ['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.REPRESENTATION_ITEM',
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.REPRESENTATION']
       * TYPEOF (psbc\presentation_style_by_context.style_context)) = 1)))
       = 0))) = 0;
 WR6 : (* for all styled_items get all assigned point_styles
          and ensure that marker_select, marker_size and
```

```
         marker_colour are valid *)
       SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
       IN TYPEOF (it)) |
       NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
       NOT (SIZEOF (QUERY (ps <* QUERY (pss <* psa.styles |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.POINT_STYLE'
       IN TYPEOF (pss)) |
       NOT (
       ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.MARKER_TYPE'
       IN TYPEOF (ps\point_style.marker))
       AND
       ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
       (ps\point_style.marker_size))
       AND
       (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
       'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
       (ps\point_style.marker_colour)) = 1)))) = 0))) = 0))) = 0;
WR7 : (* for all styled_items get all assigned curve_styles
         and ensure that curve_width, curve_font and
         curve_colour are valid *)
       SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
       IN TYPEOF (it)) |
       NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
       NOT (SIZEOF (QUERY (cs <* QUERY (pss <* psa.styles |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE'
       IN TYPEOF (pss)) |
       NOT (
       (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
       'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
       (cs\curve_style.curve_colour)) = 1)
       AND
       ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
       (cs\curve_style.curve_width))
       AND
       (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
       'CURVE_STYLE_FONT', 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
       'DRAUGHTING_PRE_DEFINED_CURVE_FONT'] * TYPEOF
       (cs\curve_style.curve_font)) = 1)))) = 0))) = 0))) = 0;
WR8 : (* for all styled_items get all assigned surface_style_usages
         and ensure that its style is a surface_side_style *)
       SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
       IN TYPEOF (it)) |
       NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
       NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
       'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
       IN TYPEOF (pss)) |
       NOT ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_SIDE_STYLE'
```

```
      IN TYPEOF (ssu\surface_style_usage.style)) )) = 0))) = 0 ))) = 0;
WR9 : (* for all styled_items get all assigned surface_style_usages
         and the surface_side_styles that they reference, and ensure
         that the styles referenced by those surface_side_styles
         are among the valid subset *)
      SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
      IN TYPEOF (it)) |
      NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
      NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
      IN TYPEOF (pss)) |
      NOT (SIZEOF (QUERY (sses <*
      ssu\surface_style_usage.style\surface_side_style.styles |
      NOT (SIZEOF (
      ['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_PARAMETER_LINE',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_CONTROL_GRID',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_SILHOUETTE',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_SEGMENTATION_CURVE',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_BOUNDARY',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_FILL_AREA',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_RENDERING'] * TYPEOF (sses)) = 1))) = 0))) = 0)))
      = 0))) = 0;
WR10: (* for all surface_style_fill_areas that are referenced by
         any surface_side_styles ensure that they are valid
         with respect to their colour representation *)
      SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
      IN TYPEOF (it)) |
      NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
      NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
      IN TYPEOF (pss)) |
      NOT (SIZEOF (QUERY (ssfa <* QUERY (sses <*
      ssu\surface_style_usage.style\surface_side_style.styles |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_FILL_AREA'
      IN TYPEOF (sses)) |
      NOT (SIZEOF (QUERY (fss <*
      ssfa\surface_style_fill_area.fill_area.fill_styles |
      NOT (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'FILL_AREA_STYLE_COLOUR' IN TYPEOF (fss))
      AND
      (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
```

```
      (fss\fill_area_style_colour.fill_colour)) = 1)))) = 0))) = 0)))
      = 0))) = 0))) = 0;
WR11: (* for all surface_style_parameter_lines that are referenced by
         any surface_side_styles ensure that they are valid
         with respect to the applied curve_style, which may include
         rendering *)
      SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
      IN TYPEOF (it)) |
      NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
      NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
      IN TYPEOF (pss)) |
      NOT (SIZEOF (QUERY (sspl <* QUERY (sses <*
      ssu\surface_style_usage.style\surface_side_style.styles |
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'SURFACE_STYLE_PARAMETER_LINE' IN TYPEOF (sses)) |
      NOT ((
      ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE' IN TYPEOF
      (sspl\surface_style_parameter_line.style_of_parameter_lines))
      AND
      (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
      (sspl\surface_style_parameter_line.
      style_of_parameter_lines\curve_style.curve_colour)) = 1)
      AND
      ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
      (sspl\surface_style_parameter_line.
      style_of_parameter_lines\curve_style.curve_width))
      AND
      (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'CURVE_STYLE_FONT', 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'DRAUGHTING_PRE_DEFINED_CURVE_FONT'] * TYPEOF
      (sspl\surface_style_parameter_line.
      style_of_parameter_lines\curve_style.curve_font)) = 1))
      OR
      (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE_RENDERING'
      IN TYPEOF
      (sspl\surface_style_parameter_line.style_of_parameter_lines))
      AND
      (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
      'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
      'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
      (sspl\surface_style_parameter_line.style_of_parameter_lines\
      curve_style_rendering.rendering_properties.rendered_colour))
      = 1))) )) = 0))) = 0))) = 0))) = 0;
WR12: (* for all surface_style_control_grids that are referenced by
         any surface_side_styles ensure that they are valid
         with respect to the applied curve_style, which may include
         rendering *)
      SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
```

```
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
        IN TYPEOF (it)) |
        NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
        NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF (pss)) |
        NOT (SIZEOF (QUERY (sscg <* QUERY (sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'SURFACE_STYLE_CONTROL_GRID' IN TYPEOF (sses)) |
        NOT ((
        ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE'
        IN TYPEOF (sscg\surface_style_control_grid.style_of_control_grid))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (sscg\surface_style_control_grid.
        style_of_control_grid\curve_style.curve_colour)) = 1)
        AND
        ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
        (sscg\surface_style_control_grid.
        style_of_control_grid\curve_style.curve_width))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CURVE_STYLE_FONT', 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT'] * TYPEOF
        (sscg\surface_style_control_grid.
        style_of_control_grid\curve_style.curve_font)) = 1))
        OR
        (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE_RENDERING'
        IN TYPEOF (sscg\surface_style_control_grid.style_of_control_grid))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (sscg\surface_style_control_grid.style_of_control_grid\
        curve_style_rendering.rendering_properties.rendered_colour))
        = 1))) )) = 0))) = 0))) = 0))) = 0;
  WR13: (* for all surface_style_silhouettes that are referenced by
           any surface_side_styles ensure that they are valid
           with respect to the applied curve_style, which may include
           rendering *)
        SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
        IN TYPEOF (it)) |
        NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
        NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF (pss)) |
        NOT (SIZEOF (QUERY (sssh <* QUERY (sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
```

```
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'SURFACE_STYLE_SILHOUETTE' IN TYPEOF (sses)) |
        NOT ((
        ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE'
        IN TYPEOF (sssh\surface_style_silhouette.style_of_silhouette))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (sssh\surface_style_silhouette.
        style_of_silhouette\curve_style.curve_colour)) = 1)
        AND
        ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
        (sssh\surface_style_silhouette.
        style_of_silhouette\curve_style.curve_width))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CURVE_STYLE_FONT', 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT'] * TYPEOF
        (sssh\surface_style_silhouette.
        style_of_silhouette\curve_style.curve_font)) = 1))
        OR
        (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE_RENDERING'
        IN TYPEOF (sssh\surface_style_silhouette.style_of_silhouette))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (sssh\surface_style_silhouette.style_of_silhouette\
        curve_style_rendering.rendering_properties.rendered_colour))
        = 1))) )) = 0))) = 0))) = 0))) = 0;
WR14: (* for all surface_style_segmentation_curves that are referenced by
         any surface_side_styles ensure that they are valid
         with respect to the applied curve_style, which may include
         rendering *)
        SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
        IN TYPEOF (it)) |
        NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
        NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF (pss)) |
        NOT (SIZEOF (QUERY (sssc <* QUERY (sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'SURFACE_STYLE_SEGMENTATION_CURVE' IN TYPEOF (sses)) |
        NOT ((
        ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE'
        IN TYPEOF
        (sssc\surface_style_segmentation_curve.style_of_segmentation_curve))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
```

```
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve\curve_style.curve_colour)) = 1)
        AND
        ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
        (sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve\curve_style.curve_width))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CURVE_STYLE_FONT', 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT'] * TYPEOF
        (sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve\curve_style.curve_font)) = 1))
        OR
        (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE_RENDERING'
        IN TYPEOF (sssc\surface_style_segmentation_curve.
        style_of_segmentation_curve))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (sssc\surface_style_segmentation_curve.style_of_segmentation_curve\
        curve_style_rendering.rendering_properties.rendered_colour))
        = 1))) )) = 0))) = 0))) = 0))) = 0;
  WR15: (* for all surface_style_boundaries that are referenced by
           any surface_side_styles ensure that they are valid
           with respect to the applied curve_style, which may include
           rendering *)
        SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
        IN TYPEOF (it)) |
        NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
        NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF (pss)) |
        NOT (SIZEOF (QUERY (ssbd <* QUERY (sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'SURFACE_STYLE_BOUNDARY' IN TYPEOF (sses)) |
        NOT ((
        ('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE'
        IN TYPEOF (ssbd\surface_style_boundary.style_of_boundary))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (ssbd\surface_style_boundary.
        style_of_boundary\curve_style.curve_colour)) = 1)
        AND
        ('MEASURE_SCHEMA.POSITIVE_LENGTH_MEASURE' IN TYPEOF
        (ssbd\surface_style_boundary.
```

```
        style_of_boundary\curve_style.curve_width))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'CURVE_STYLE_FONT', 'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_CURVE_FONT'] * TYPEOF
        (ssbd\surface_style_boundary.
        style_of_boundary\curve_style.curve_font)) = 1))
        OR
        (('AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.CURVE_STYLE_RENDERING'
        IN TYPEOF (ssbd\surface_style_boundary.style_of_boundary))
        AND
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (ssbd\surface_style_boundary.style_of_boundary\
        curve_style_rendering.rendering_properties.rendered_colour))
        = 1))) )) = 0))) = 0))) = 0))) = 0;
  WR16: (* for all surface_style_renderings that are referenced by
           any surface_side_styles ensure that the colour
           representation is valid *)
        SIZEOF (QUERY (si <* QUERY (it <* SELF.items |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.STYLED_ITEM'
        IN TYPEOF (it)) |
        NOT (SIZEOF (QUERY (psa <* si\styled_item.styles |
        NOT (SIZEOF (QUERY (ssu <* QUERY (pss <* psa.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.SURFACE_STYLE_USAGE'
        IN TYPEOF (pss)) |
        NOT (SIZEOF (QUERY (ssre <* QUERY (sses <*
        ssu\surface_style_usage.style\surface_side_style.styles |
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'SURFACE_STYLE_RENDERING' IN TYPEOF (sses)) |
        NOT
        (SIZEOF (['AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.COLOUR_RGB',
        'AIC_MECHANICAL_DESIGN_SHADED_PRESENTATION.'+
        'DRAUGHTING_PRE_DEFINED_COLOUR'] * TYPEOF
        (ssre\surface_style_rendering.surface_colour)) = 1)))
        = 0))) = 0))) = 0))) = 0;

END_ENTITY;
(*
```

Formal propositions:

WR1: Each entity in the set of **items** shall be a **styled_item**, a **mapped_item**, an **axis2_placement**, or a **camera_model_d3**.

WR2: The **mapped_representation** of the **representation_map** that is the **mapping_source** of a **mapped_item** in a **mechanical_design_shaded_presentation_representation** shall be a **shape_representation** or another **mechanical_design_shaded_presentation_representation**.

WR3: The item of a **styled_item** may be a **mapped_item** only, if the **mapped_item** has a **shape_representation** as its **mapped_representation**.

WR4: Each item in the set of **styles** of a **presentation_style_assignment** that is referenced by a **styled_item** in the set of **items** shall be either a **point_style**, **curve_style**, or **surface_style_usage**.

WR5: The **style_context** attribute of a **presentation_style_by_context** shall be either a **representation** or a **representation_item**.

WR6: For each **point_style** in the set of **styles** of a **presentation_style_assignment** that is referenced by a **styled_item** in the set of **items** the **marker_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **marker_size** attribute shall be a **positive_length_measure**; the **marker** attribute shall be a **marker_type**.

WR7: For each **curve_style** in the set of **styles** of a **presentation_style_assignment** that is referenced by a **styled_item** in the set of **items** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**.

WR8: The **style** attribute of each **surface_style_usage** in the set of **styles** of a **presentation_style_assignment** that is referenced by a **styled_item** in the set of **items** shall be a **surface_side_style**.

WR9: Each item in the set of **styles** of a **surface_side_style** shall be either a **surface_style_parameter_line**, **surface_style_control_grid**, **surface_style_silhouette**, **surface_style_segmentation_curve**, **surface_style_boundary**, **surface_style_fill_area**, or **surface_style_rendering**.

WR10: Each item in the set of **fill_styles** of a **fill_area_style** shall be a **fill_area_style_colour**, and the **fill_colour** attribute of the **fill_area_style_colour** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

WR11: The **style_of_parameter_lines** attribute of a **surface_style_parameter_line** shall be a **curve_style_rendering** or a **curve_style**. In the case of **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**. In the case of **curve_style_rendering** the **rendered_colour** attribute of **rendering_properties** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

WR12: The **style_of_control_grid** attribute of a **surface_style_control_grid** shall be a **curve_style_rendering** or a **curve_style**. In the case of **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**. In the case of **curve_style_rendering** the **rendered_colour** attribute of **rendering_properties** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

WR13: The **style_of_silhouette** attribute of a **surface_style_silhouette** shall be a **curve_style_rendering** or a **curve_style**. In the case of **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**. In the case of **curve_style_rendering** the **rendered_colour** attribute of **rendering_properties** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

WR14: The **style_of_segmentation_curve** attribute of a **surface_style_segmentation_curve** shall be a **curve_style_rendering** or a **curve_style**. In the case of **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**. In the case of **curve_style_rendering** the **rendered_colour** attribute of **rendering_properties** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

WR15: The **style_of_boundary** attribute of a **surface_style_boundary** shall be a **curve_style_rendering** or a **curve_style**. In the case of **curve_style** the **curve_colour** attribute shall be either a **colour_rgb** or a **draughting_pre_defined_colour**; the **curve_width** attribute shall be a **positive_length_measure**; the **curve_font** attribute shall be either a **curve_style_font** or a **draughting_pre_defined_curve_font**. In the case of **curve_style_rendering** the **rendered_colour** attribute of **rendering_properties** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

WR16: The **surface_colour** attribute of a **surface_style_rendering** shall be either a **colour_rgb** or a **draughting_pre_defined_colour**.

Informal propositions:

IP1: If the **item** of each **styled_item** in a **mechanical_design_shaded_presentation_representation** is a **geometric_representation_item** or a **topological_representation_item** those shall be within the reference tree of a **shape_representation** that is presented in the same **presentation_view** as the **mechanical_design_shaded_presentation_representation**.

```
*)
END_SCHEMA; -- aic_mechanical_design_shaded_presentation
(*
```

Annex A
(normative)

Short names of entities

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

Table A.1 – Short names of entities

Entity data types names	Short names
MECHANICAL_DESIGN_SHADED_PRESENTATION_AREA	MDSPA
MECHANICAL_DESIGN_SHADED_PRESENTATION_REPRESENTATION	MDSPR

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(518) 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

To provide for unambiguous identification of the aic-mechanical-design-shaded-presentation in an open information system, the schema identifier

{ iso standard 10303 part(518) version(1) schema(1) aic-mechanical-design-shaded-presentation(1) }

is assigned to the **aic_mechanical_design_shaded_presentation** schema (see clause 4). The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

Annex C
(informative)

EXPRESS-G diagrams

The diagrams in this annex are generated from the short listing given in clause 4 and correspond to the EXPRESS schemas specified in this part of ISO 10303. 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 select types founded_item_select, geometric_set_select, layered_item, measure_value, presentation_representation_select, trimming_select, and vector_or_direction are interfaced into the AIC expanded listing according to the implicit interface rules of ISO 10303-11. These select types are not referenced by other entities in this part of ISO 10303.

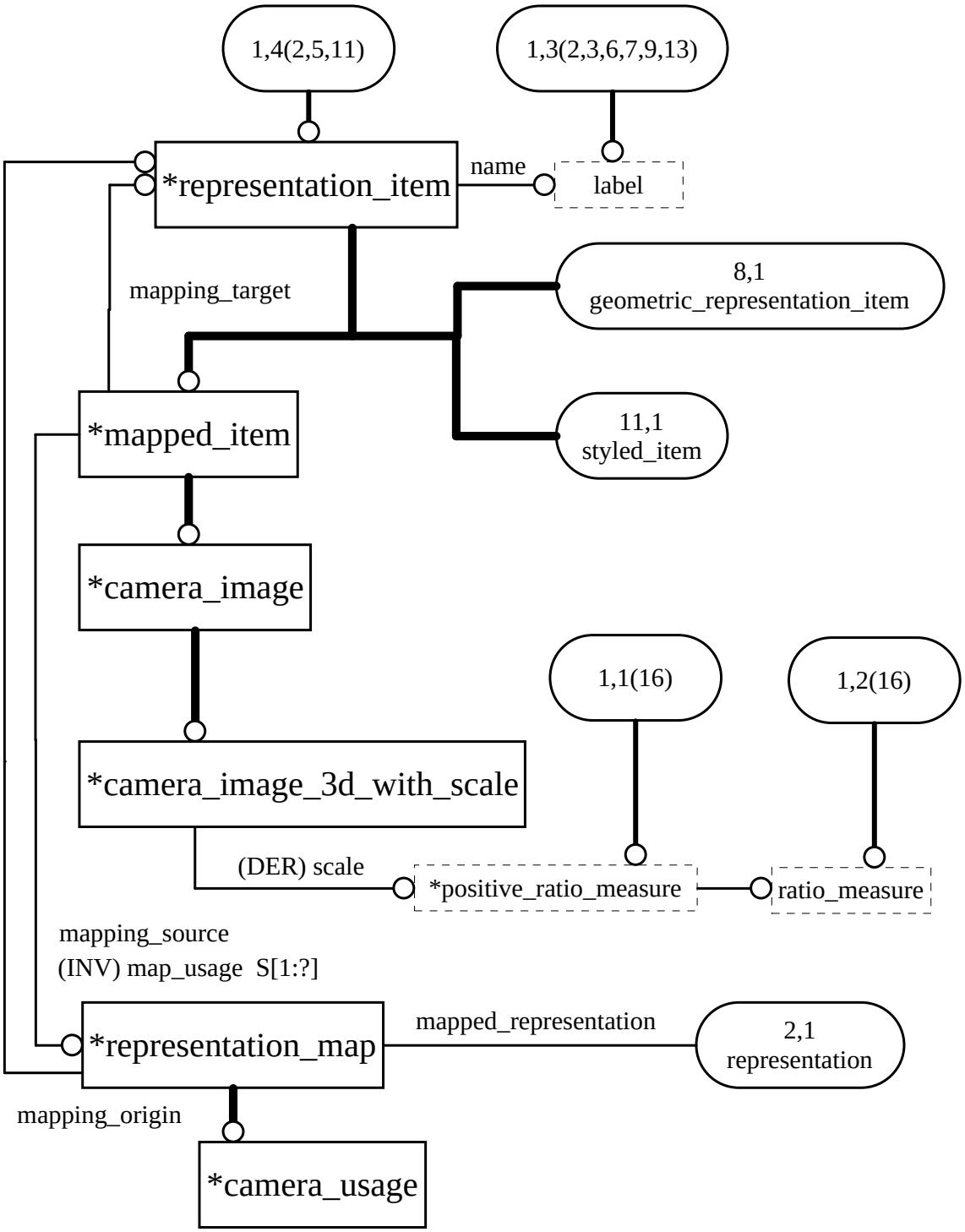


Figure C.1 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (1 of 16)

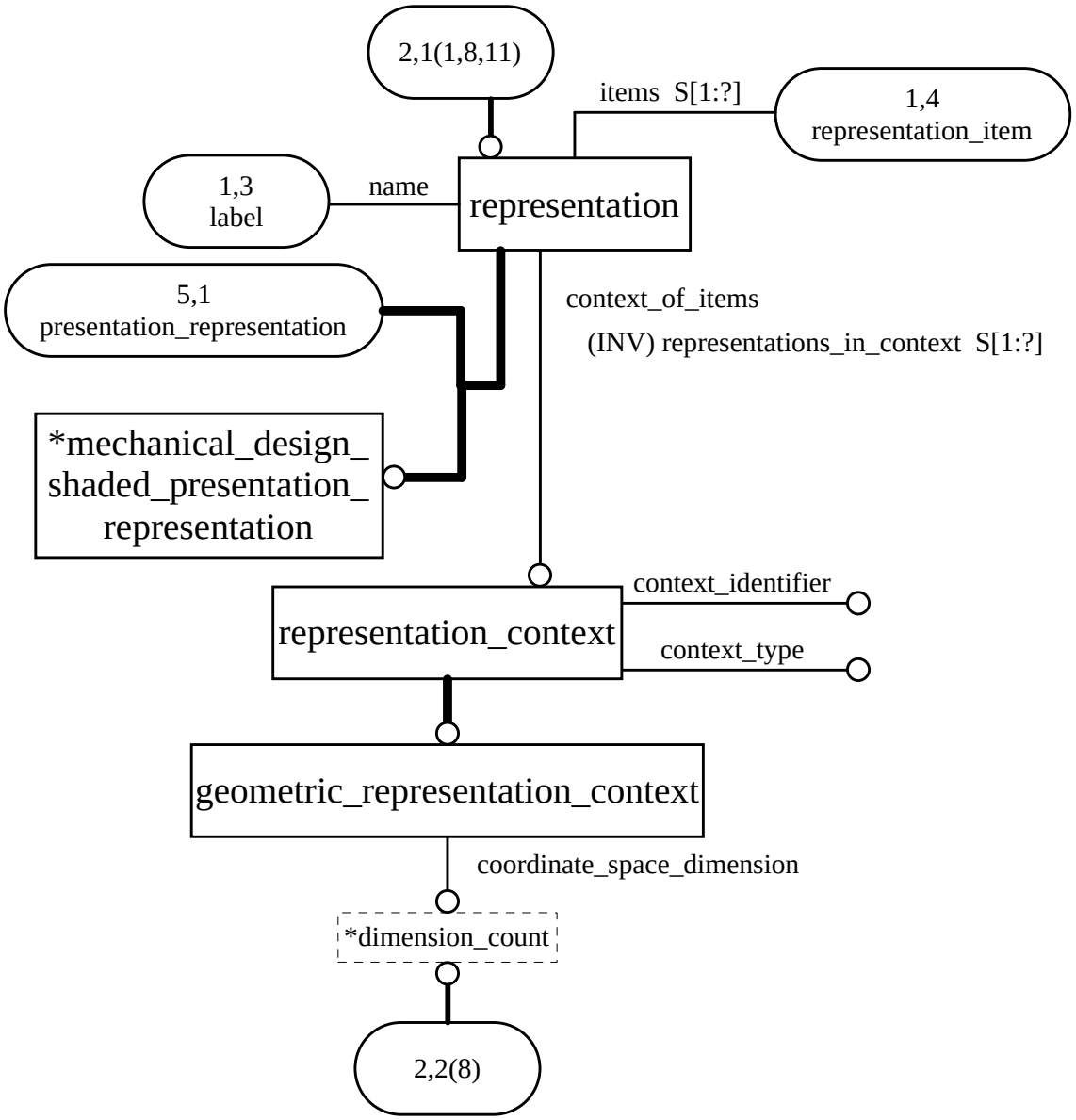


Figure C.2 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (2 of 16)

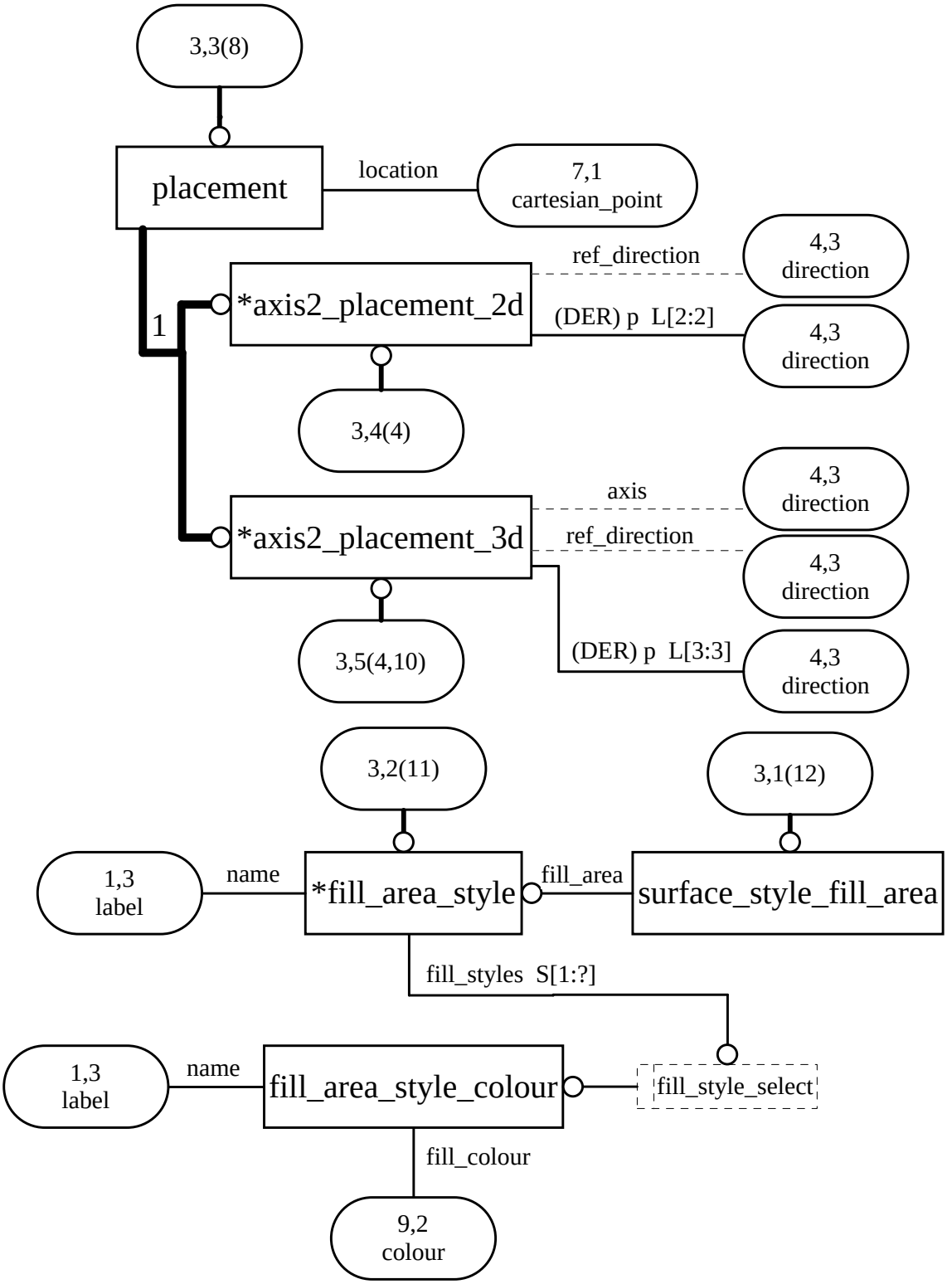


Figure C.3 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (3 of 16)

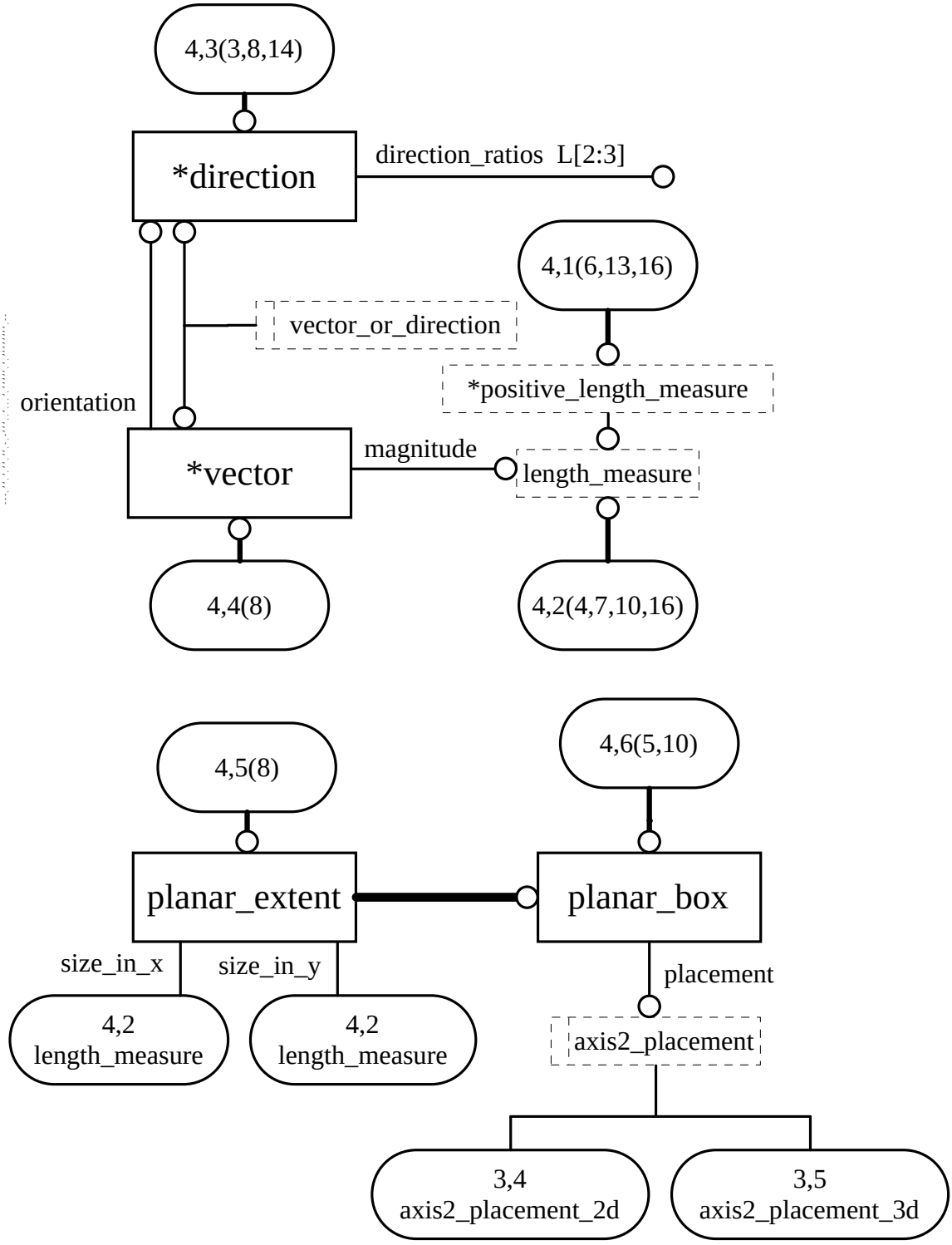


Figure C.4 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (4 of 16)

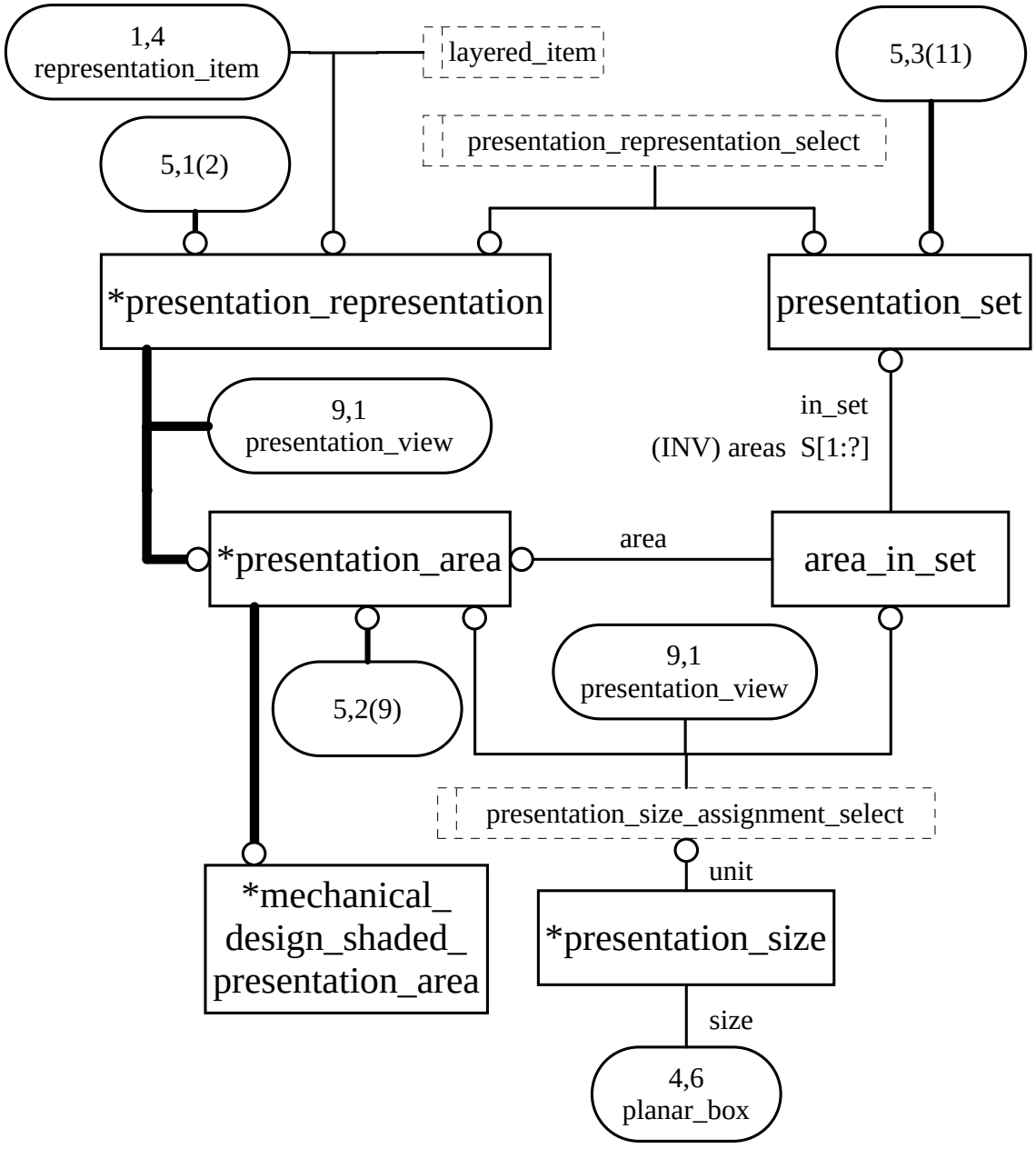


Figure C.5 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (5 of 16)

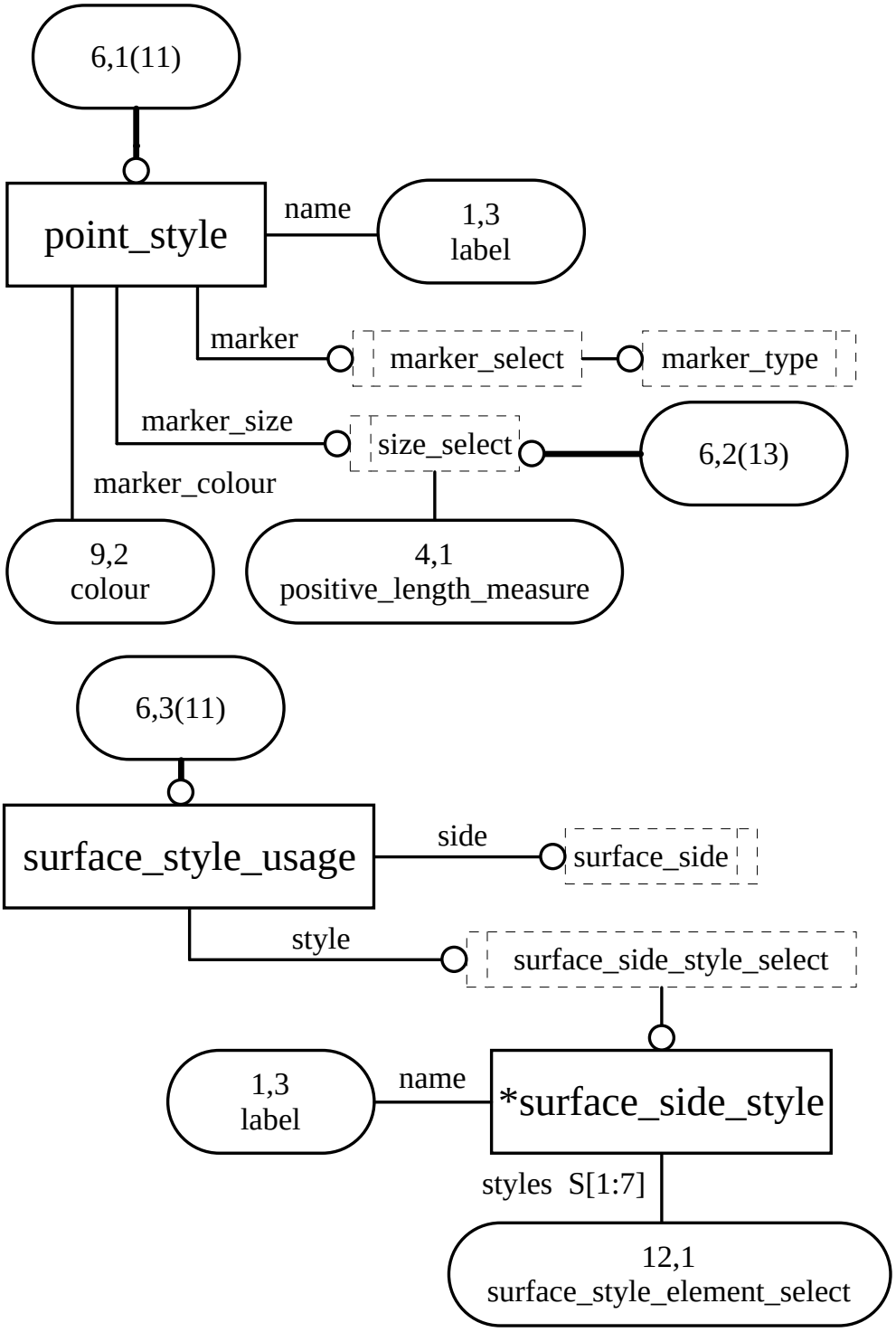
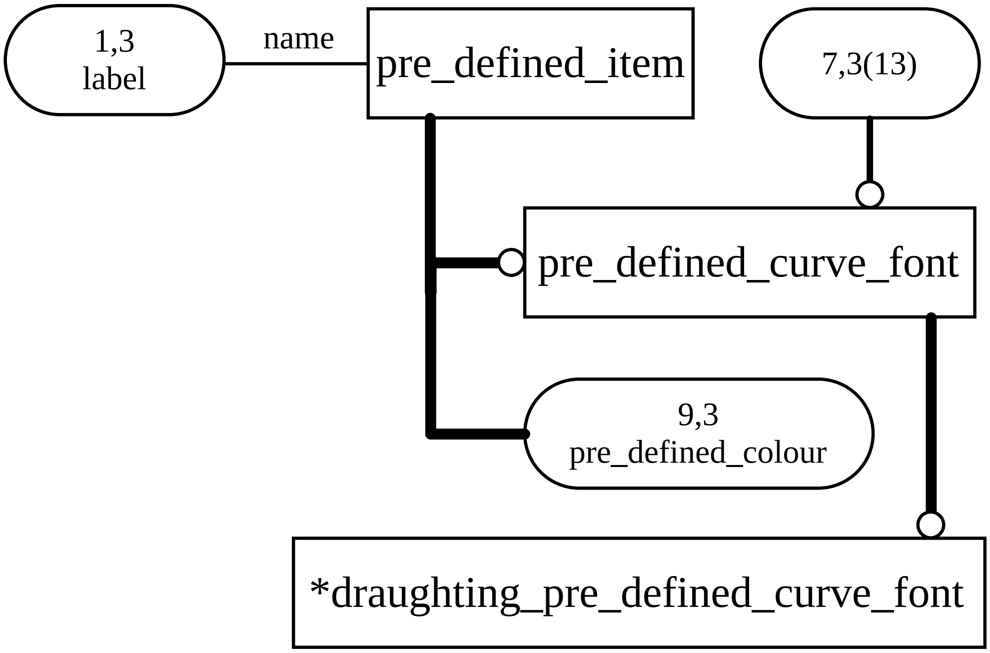


Figure C.6 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (6 of 16)



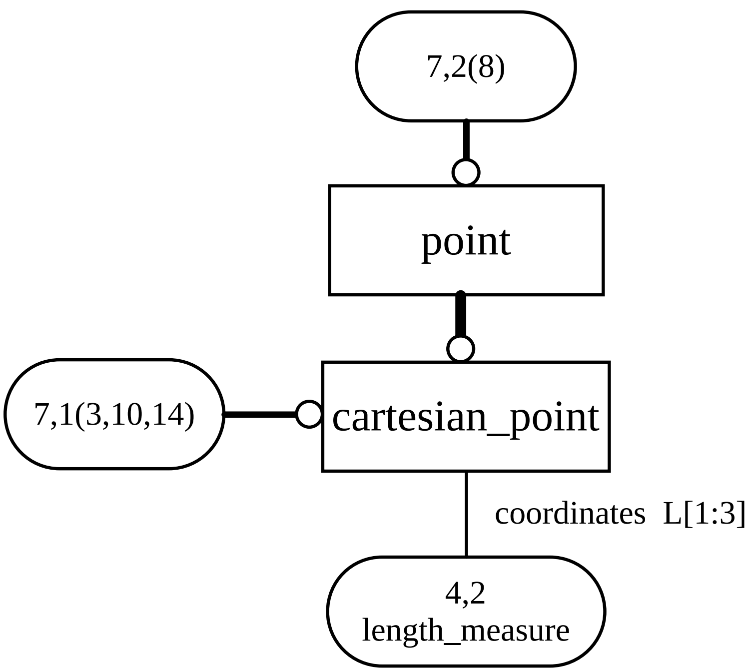


Figure C.7 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (7 of 16)

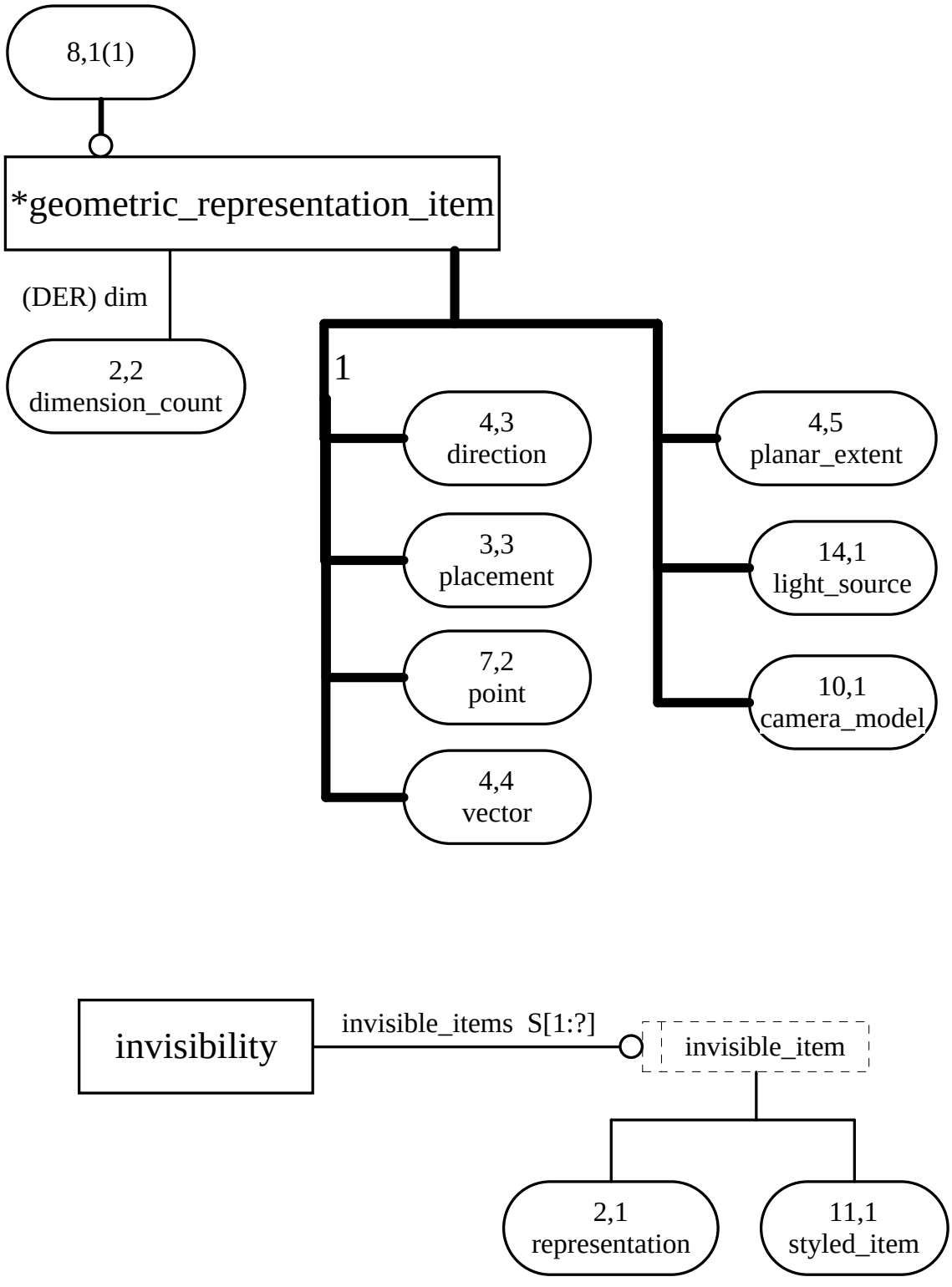


Figure C.8 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (8 of 16)

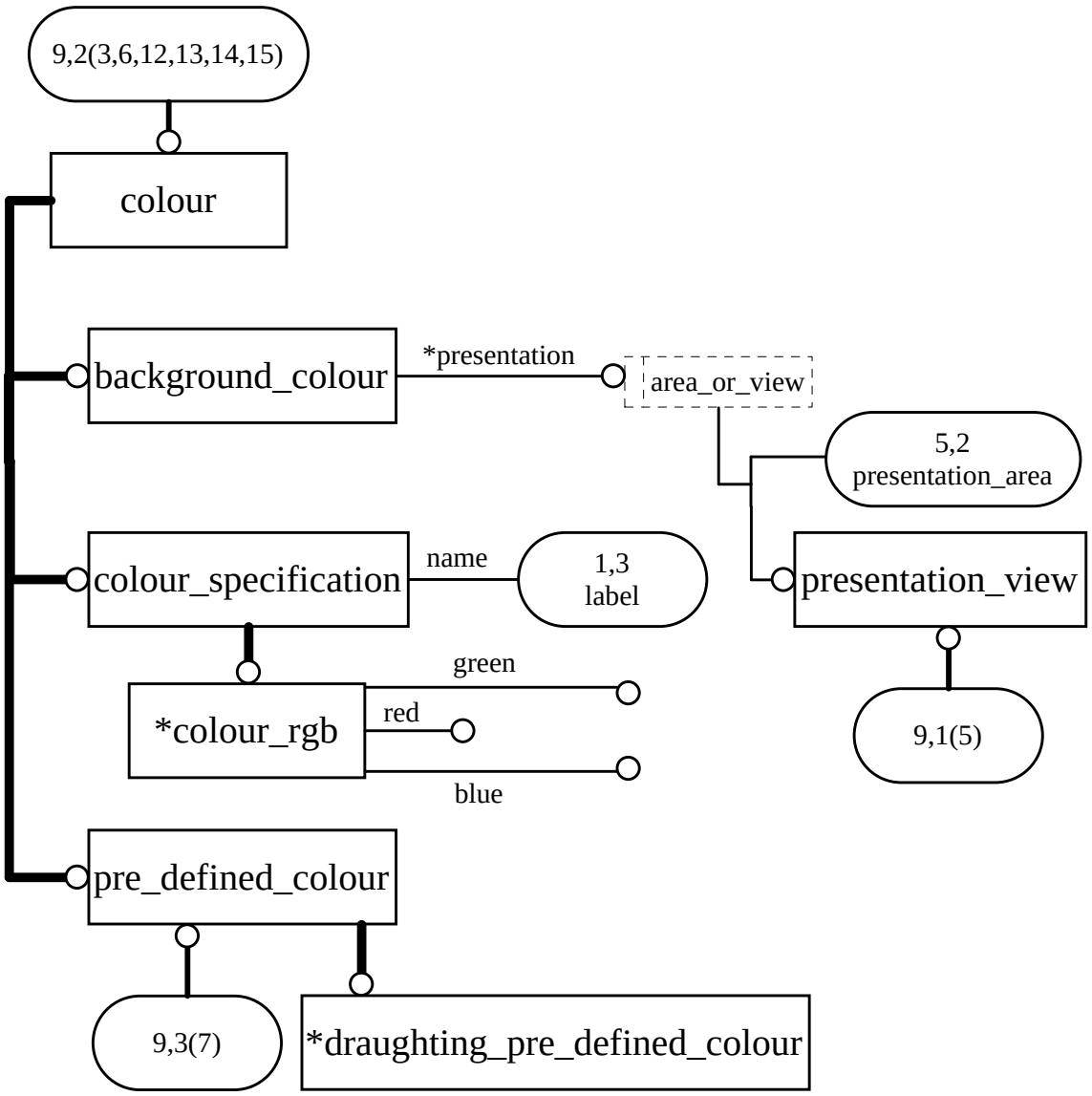


Figure C.9 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (9 of 16)

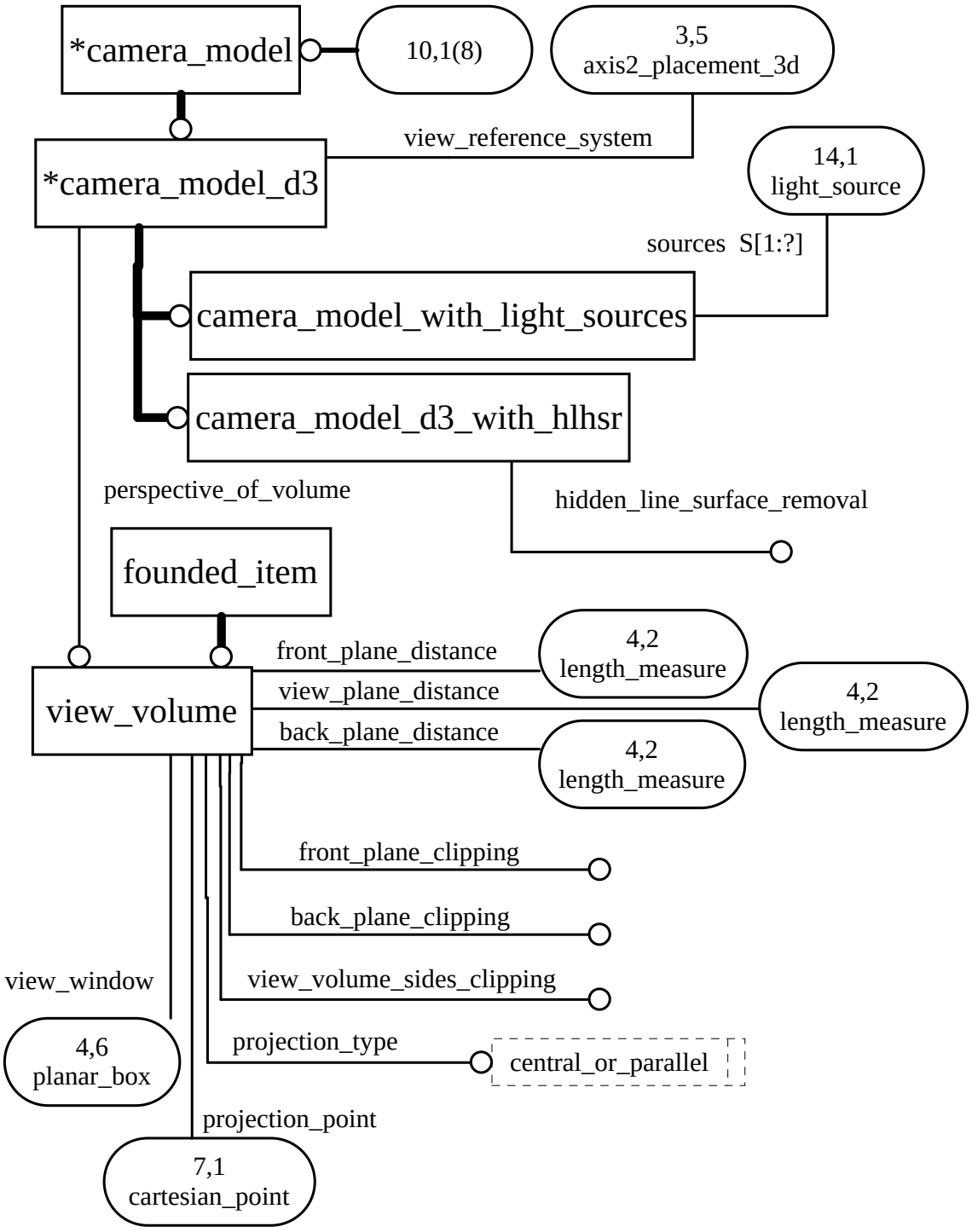


Figure C.10 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (10 of 16)

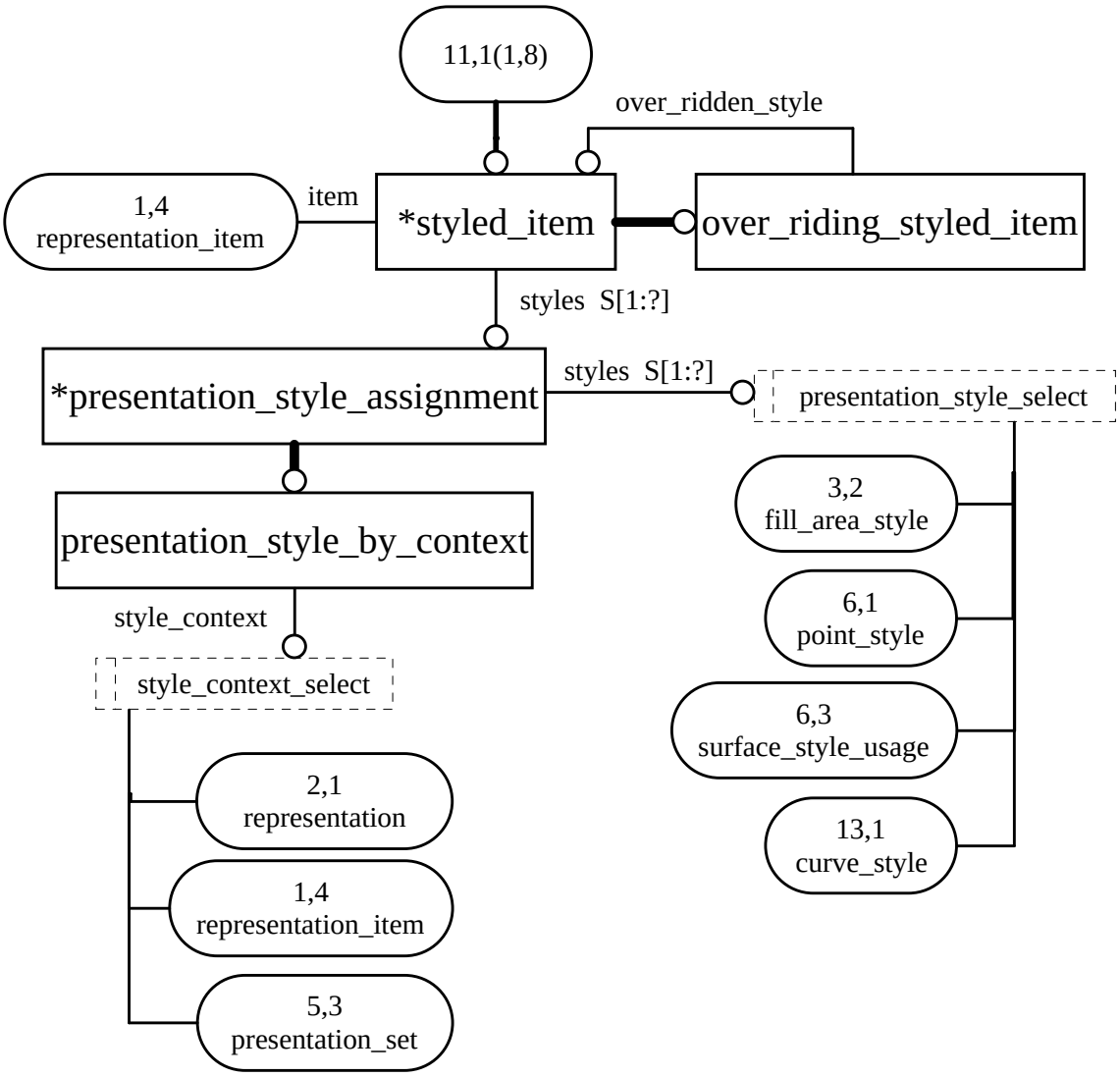


Figure C.11 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (11 of 16)

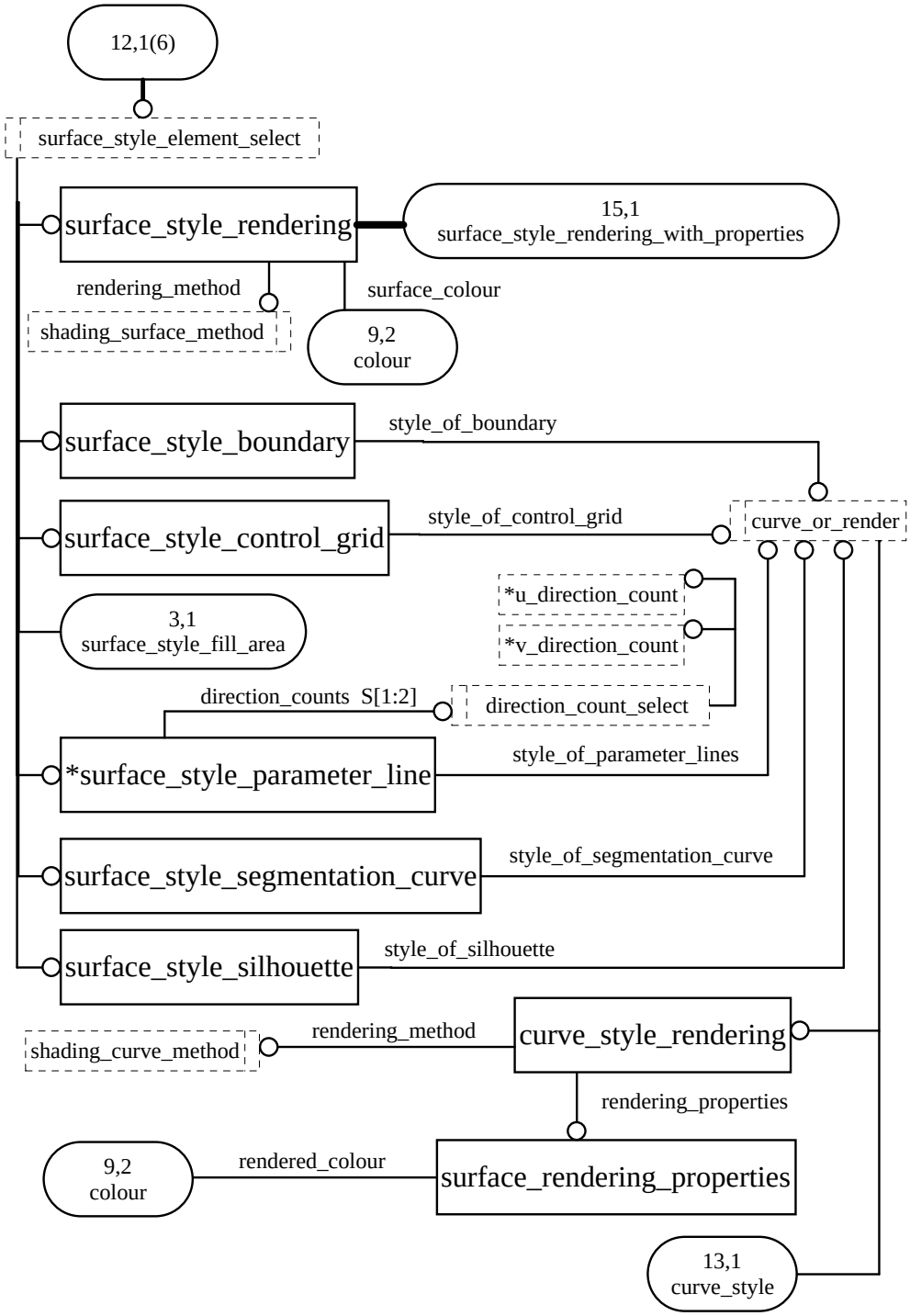


Figure C.12 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (12 of 16)

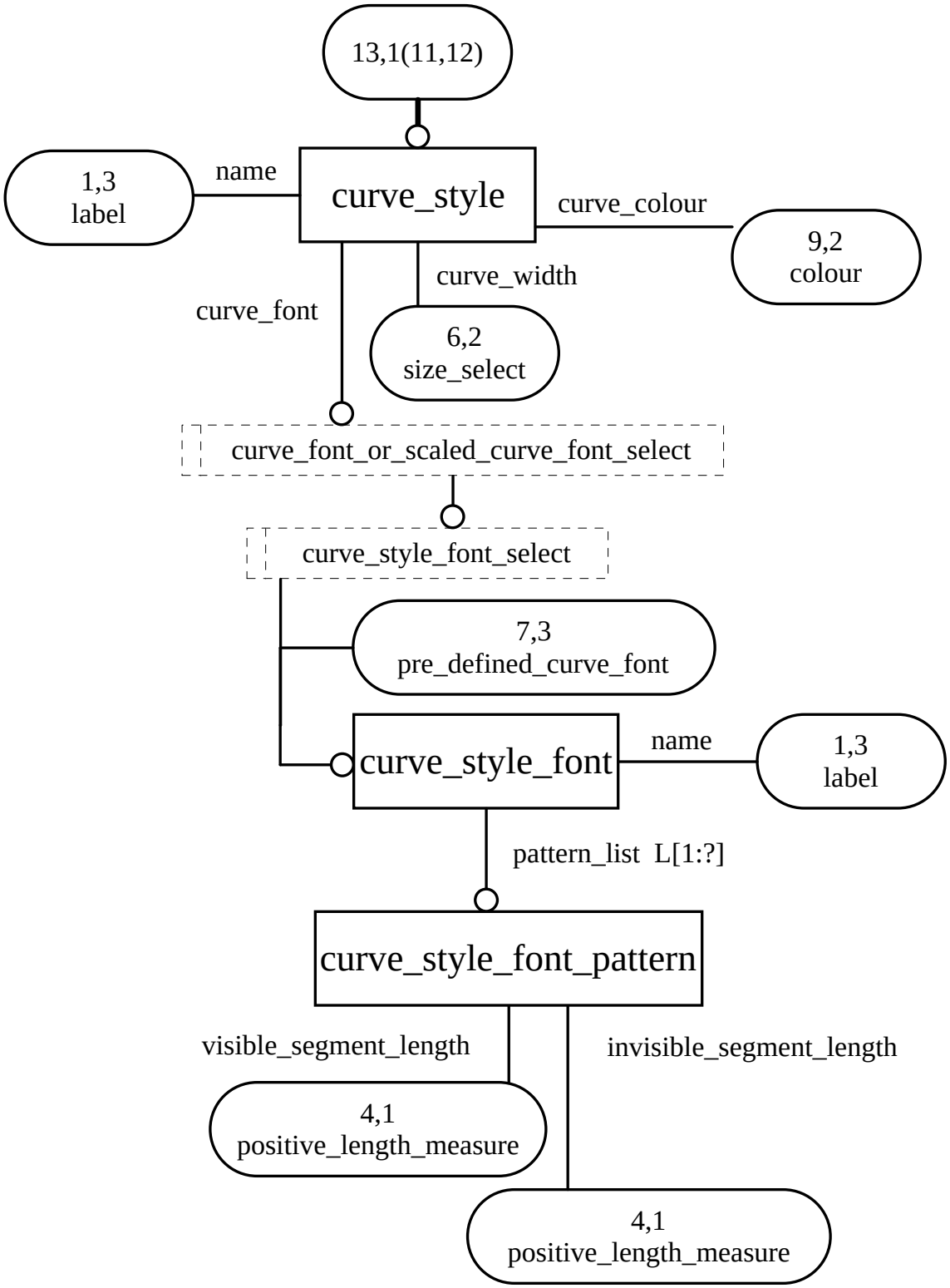


Figure C.13 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (13 of 16)

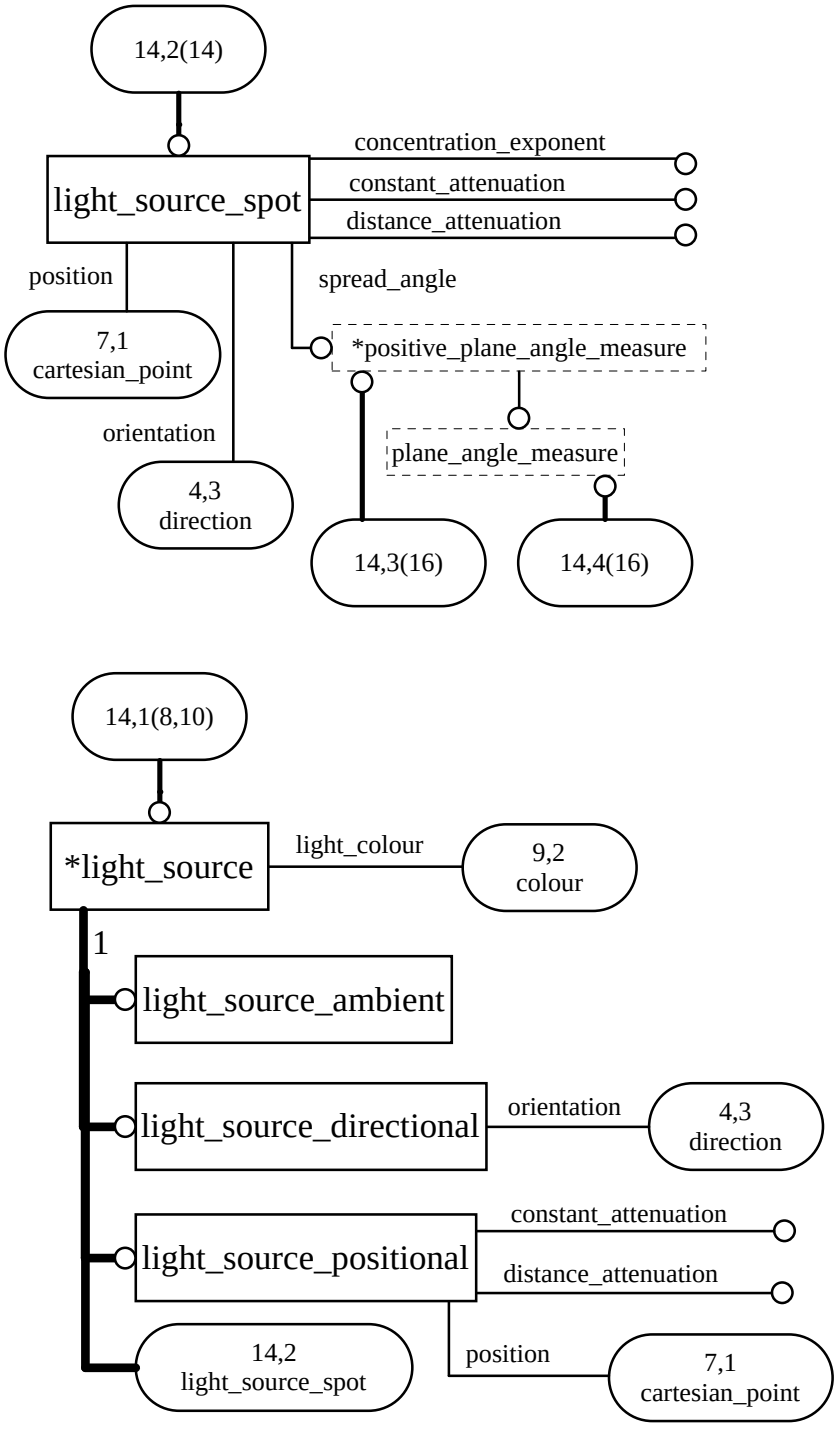


Figure C.14 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (14 of 16)

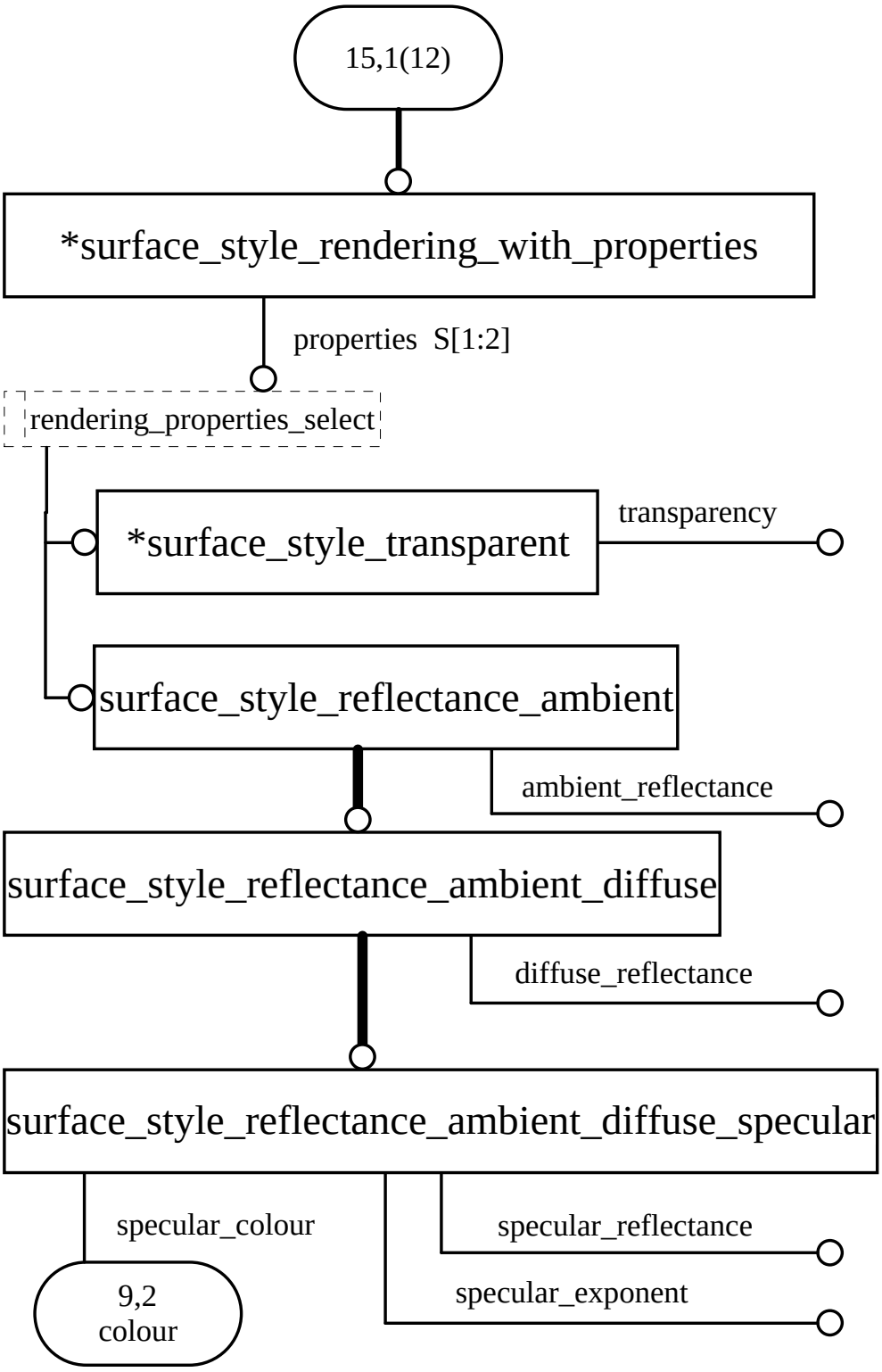


Figure C.15 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (15 of 16)

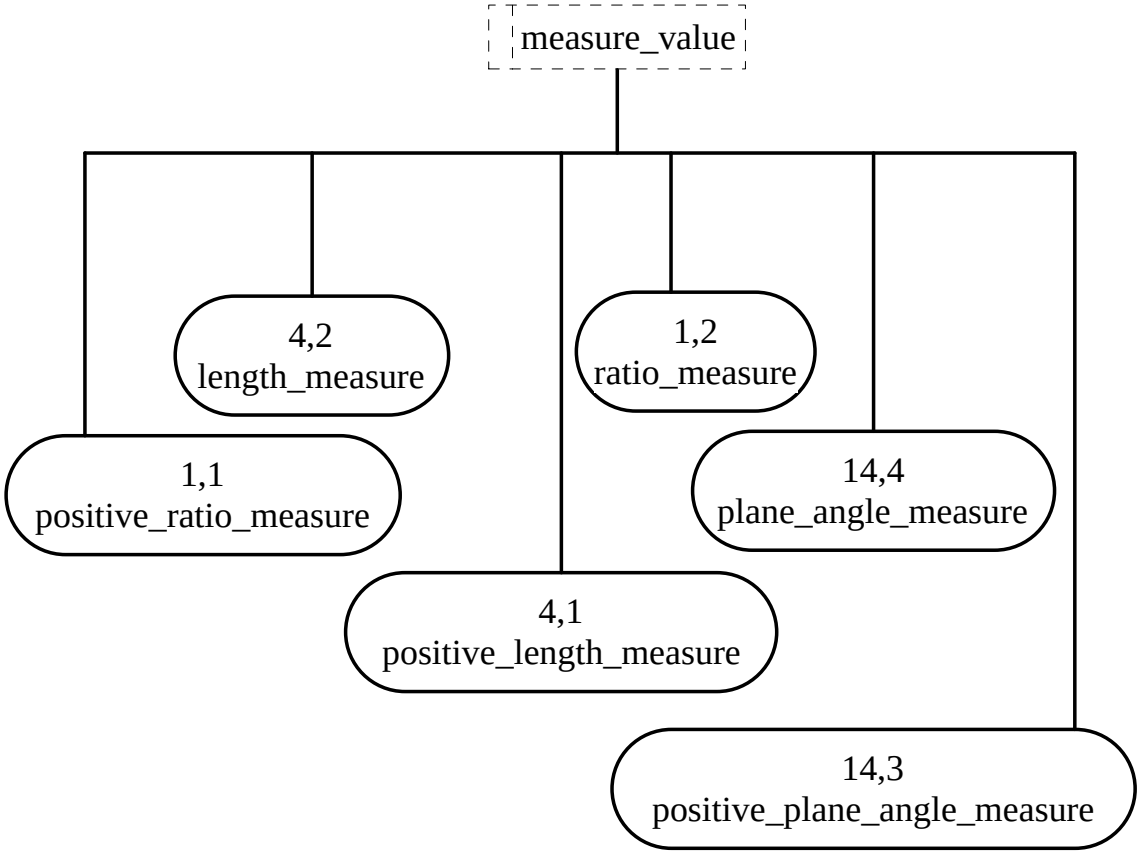


Figure C.16 – EXPRESS-G diagram of the aic_mechanical_design_shaded_presentation (16 of 16)

Annex D
(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/part518/IS/

If there is difficulty accessing these sites, contact ISO Central Secretariat or contact the ISO TC184/SC4 Secretariat directly at: 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.

Index

ICS 25.040.40

Price based on 48 pages