Recommended Practices

for

Composite Structure Validation Properties

Release 1.0

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Document History

Revision	Date	Change
0.20	2022-08-11	Final draft for team review
0.30	2025-10-20	Editorial revision
0.40	2026-06-02	Update of some validation property names for disambiguation / harmonization with other validation properties, including updated diagrams. Added missing Figure and Table labels.
1.0	2026-06-23	Public Release

1 Introduction

Exchange of exact geometry via STEP (using B-Rep solids or shell-based surface models) is a well-established and stable process, which has proven its worth over many years. One of the cornerstones for its reliability is the “Geometric Validation Properties”. These properties allow determining the success of a data exchange by providing key values (such as volume, area, and centroid) along with the geometry data, thus enabling a comparison after translation.

This document is intended as a supplement to the existing Recommended Practices for Composite Materials (Version 4.4, 3 December 2025), which can be found on the MBx-IF homepage under “CAx > Rec. Practices”, and adds validation properties specific to this scope.

This first version of the Recommended Practices for Composite Structure Validation Properties deals with the exact 3D implicit representation of the composite parts, i.e., where each ply is based on a surface and a contour (see figure 1, left side). This scope is fully covered in AP242. Technically, it is also covered in the older AP203 Edition 2, but has not been tested in older versions of the STEP standard.

Future editions of this document are planned to include validation properties for the 3D approximate explicit representation of the plies, in which each ply is represented by a 3D tessellated solid (see figure 1, right side). This representation is also fully supported by AP242. capability will be based on the Recommended Practices for 3D Tessellated Geometry and the respective validation properties already defined in that context.

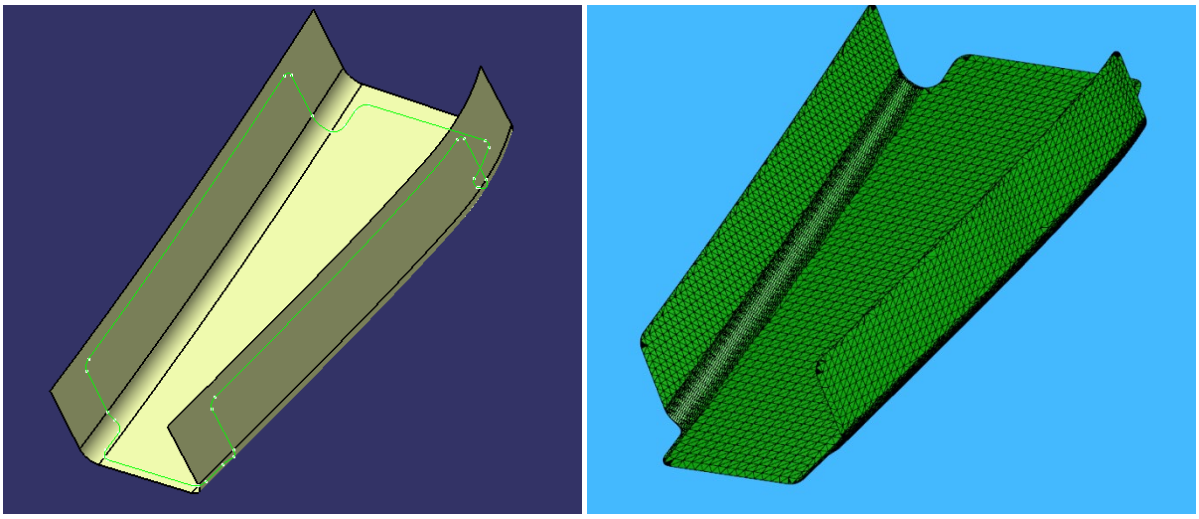

Figure 1: Illustration of the two representations of composite parts

2 Scope

The following are within scope of this document:

- The definition of user requirements for the validation properties for structures made of composite materials in STEP:
  - the list of essential information,
  - the list of validation properties,
  - the validation level,
  - the evaluation of the validation properties such as typical threshold.

- The implementation of the validation properties with STEP AP242:
  - at part level,
  - at laminate table level,
  - at sequence level,
  - at ply level.

The following are outside the scope of this document:

- The definition of the representation of composite data.

The following are outside the scope for this version of the document, but will be added at a later point in time:

- Validation for different types of rosettes

3 User requirements for the composite validation properties

The following sections cover the different types of validation properties for structures made of composite materials.

3.1 Fundamental Concepts

A validation property is a characteristic (such as volume, area or thickness) of a constituent of a composite structure, or a collection of those constituents.

When used to validate an exchange:

- These validation properties are initially calculated in their native engineering software systems and output with the composite structural information to a STEP representation.
- The receiving software would then perform the translations or transformations necessary to import the STEP representation.
- The receiving software would then calculate the values of the validation properties of the imported constituents.
- The receiving software would then compare the calculated values of the validation properties with the imported validation properties.
- If they are within an agreed tolerance the exchange is deemed to have been validated.

Some of the validation properties defined in this document are “geometric validation properties” (or GVP) defined for exact BREP geometry applied to the composite domain (see Recommended Practices for Geometric Validation Properties).

3.2 Essential information

The following table summarizes the essential information for composite structures:

Entity	Essential information	Type
Part	Name	String
	Laminate tables	List of
Laminate table	Name	String
	Base surface direction (material side specification)	Geometry
	Rosette (Reinforcement Orientation Basis)	*See below*
	Ordered Sequences	List of
Sequence	Name	String
	Plies	Set of
Ply, core, ply piece	Name	String
	Material	*See below*
	Orientation (name + values)	*See below*
	Rosette (Reinforcement Orientation Basis)	*See below*
	shape (contour, surface, 3D shapes, …)	Geometries
	Ply pieces	List of
Material	Name	String
	Mechanical Properties Attributes (density, thickness, iso-tropic, modulus, strength, etc)	

	Source Authority (e.g. catalog link, DB name, etc.)	String
	User Specific Domain Attributes	
Orientation	Name	String
	Angle value	numerical value with unit
Rosette	Name	String
	Origin	coordinates
	X direction vector	vector
	Y direction vector	vector
	Z direction vector	vector
	Rosettes definition (depending of the types)	
EOP	Name	String
	Shape	Geometry
	Classification Type (e.g. mfg excess, engineering net trim, no splice area, butt splice area, stay out area (e.g. faying region).	
	List of Associated Part(s), Laminate Tables, Associated Plies, Ply Pieces	
Point Zone	Ordered List of Plies	
	Thickness	

3.2.1 Part Name

The part name specifies the reference in the Bill of Materials for configuration control and part identification.

A composite part is represented by a `product` in STEP. The `id` and the `name` are mandatory attributes and not computable. They can't be considered as validation properties but must be preserved as mandatory attributes.

Extract of STEP MIM documentation:

```
ENTITY product;
  id:                  identifier;
  name:                label;
  description:         OPTIONAL text;
  frame_of_reference: SET[1:?] OF product_context;
END_ENTITY;
```

3.2.2 Table (Quantity and Names)

Tables specify the sequencing of layers or sequences of plies.

A table is represented by a `laminate_table`. The `id` and the `name` are mandatory attributes and not computable. They cannot be considered as validation properties but must be preserved as mandatory attributes.

3.2.3 Materials

This paragraph concerns the materials used in the definition of each table part which can be counted and used as validation property.

A material may have many specified properties but ones specific to composites conversion validation are noted below.

- Density

This is typically the density of the cured material laminate.

- Cured Thickness

The per ply thickness of a composite material after the part has been cured. This value will impact the calculated volume and overall mass.

- Mass per unit Area

Because thickness values may be different or vary, a secondary calculation is often computed using an area-based mass instead of calculating the mass based on density and volume.

A material is represented by a **stock material** (ARM) mapped to a `product_definition` (AIM) in STEP. The `name` is a mandatory attribute and not computable.

Material properties are represented by the `property_definition` subtype `material_property`. The `name` attribute inherited from the `property_definition` supertype is used to denote the particular property being qualified or quantified. The `material_property_representation` entity links a `material_property` to a `representation` that may contain a `measure_representation_item` in its set of items to provide a quantitative value the property.

All these attributes and associated values cannot be considered as validation properties but must be preserved as any attributes.

3.2.4 Orientations

The orientations used in the definition of each table part which can be counted and used as validation property.

3.2.5 Sequence

Sequences specify the stacking (lay-up) order of the layers of material (plies) in a laminate table.

3.2.5.1 Names

A sequence is represented by a `ply_laminate_sequence_definition` or `composite_assembly_sequence_definition`. The `id` and the `name` are mandatory attributes and not computable. They cannot be considered as validation properties but must be preserved as mandatory attributes.

3.2.5.2 Order

The order of the plies and cores in a composite part is very important to preserve.

In a sequence the order of the plies doesn't matter. It's the order of the sequences which have to be preserved at PlyLaminateTable or CompositeAssembly level. It is the sequences order that needs to be preserved.

3.2.6 Ply (Quantity, Names, Order, Attributes, Geometry)

Plies specify the geometry, material and fiber direction for each layer of a composite part.

For this document, cores and ply pieces are considered as plies: They will have the same validation properties.

3.2.6.1 Quantity

Check the total number of plies or cores per table.

3.2.6.2 Names (numbers)

The name of a ply, core or ply piece (or ply identifier / number) allows for the user to validate the conversion on a ply-by-ply basis.

A ply is represented by a **ply** (ARM) mapped to a `product_definition` (AIM) in STEP. The `id` and the `name` are mandatory attributes and not computable. They cannot be considered as validation properties but must be preserved as mandatory attributes.

3.2.6.3 Attributes

For the purpose of this document, ply attributes include material, orientation, rosette, reference surface, and draping direction.

- **Material - NAMING**

The material specified for each ply controls the overall properties of a part and will impact the other properties including volume and mass.

- **Orientation**

The orientation specified for a ply controls the fiber direction for the represented material layer. The Orientation is in reference to the rosette origin. 0deg = X-Axis direction of the rosette and 90deg = Y-Axis of the rosette.

- **Rosette**

The rosette axis is the reference for the fiber directions as specified by the Orientation property of a ply. Therefore it is important to validate the conversion of the rosette axis.

  - Origin

    The origin specifies the location of the rosette axis. Typically, the rosette position is not as critical to the design intent of a composite part, as is the direction vectors of the x and y axis.

  - X-Axis and Y-Axis

    Represent the 0-degree and 90-degree fiber direction (respectively).

  - Z-Axis line

    The Z-axis does not specify anything specific for a composite part but may have been used as a reference for the draping direction or other aspects of the design.

For validation, the value of the attribute rosette (name) is mandatory attribute and not computable. It cannot be considered as validation property but must be preserved as mandatory attribute.

- **Transformation Intent – mapping**

For validation, it is very important to preserve the association ply/rosette.

In order to have a property to compute and compare with the initial value computed in the initial system before the export, a solution is to:

- Calculate the centroid of the 3D contour of each ply
- Apply the Rosette matrix positioning of the ply to the centroid
- Store the transformed centroid of each ply

The name of this validation shall be: 'notional rosette centroid'.

- **Basis Surface**

The basis (tool) surface provides a reference for the ply geometry.

For the validation of the basis surface of the ply, the link with the reference surface is not a re-computable attribute. It will be preserved with STEP classic mechanism.

The surface will be validated with classic geometric validation properties (see Geometry paragraph below).

- **Geometry**

Geometry represents the physical shape.
For a ply, it is generally specified as one or more closed contours (wireframe) on a reference surface. The contours are used to define a bounded area on the reference surface.
In the future the geometry of the ply could be represented by a 3D tessellated solid
For a core, the geometry is the 3D physical shape of the core.

For the validation of the geometry, we will use the classic geometric validation properties:

- For a boundary surface: centroid and surface area.
- For a solid: centroid, volume and surface area

Remark:

A centroid is the center of volume of a geometric solid model, or the center of area for a surface model. The position of the centroid is an invariant datum relative to the model origin, thus during an exchange, this can be used to validate the positional integrity of any geometric translations.

For a composite part, the centroid of each ply should be compared to validate the positional accuracy of the conversion.

3.3 Validation Levels

The notion of validation levels has been introduced by the LOTAR standards. The validation levels may be also relevant for data exchange.

Extract of LOTAR Part 005 section 6.2.2 Specification of Validation Levels:

> In order to manage the integrity of content and the risk of data or information loss during the LTA LOTAR introduces a concept of validation levels.
>
> These levels are:

Validation Level	Method	Risk
0	No validation properties applied	Maximum
1	Mandatory validation properties	Calculated risk
2	Mandatory plus optional properties	Minimized risk

Table 1: Validation Levels

3.4 Composite Validation Properties

The following section defines the Validation properties, the validation level and a typical tolerance threshold for a successful conversion.

4 Composite Validation Properties

Each of the PMI Validation Properties described below follows the exact same pattern for its definition: `property_definiton` ← `property_definition_representation` → `representation` → `representatation_item`. In a larger file, where there are many validation properties, this can result in a significant number of entities, especially representations, which may have an impact on system performance.

Multiple validation properties can be combined so they share the same `property_definition`, `property_definition_representation` and `representation`.

Validation properties can be combined in this way, if they are:

- of the same type (`property_definition.name`)
- attached to the same model element (`property_definition.definition`)

Note: the `representation.name` has to be empty. The individual validation properties can be distinguished by their respective `representation_item.name`. Since each validation property is instantiated at most once per model element, this does not introduce any ambiguities.

4.1 Composite validation properties at part level

For the composite validation properties at part level, the `property_definition` shall be attached to the `product_definition` of the part.

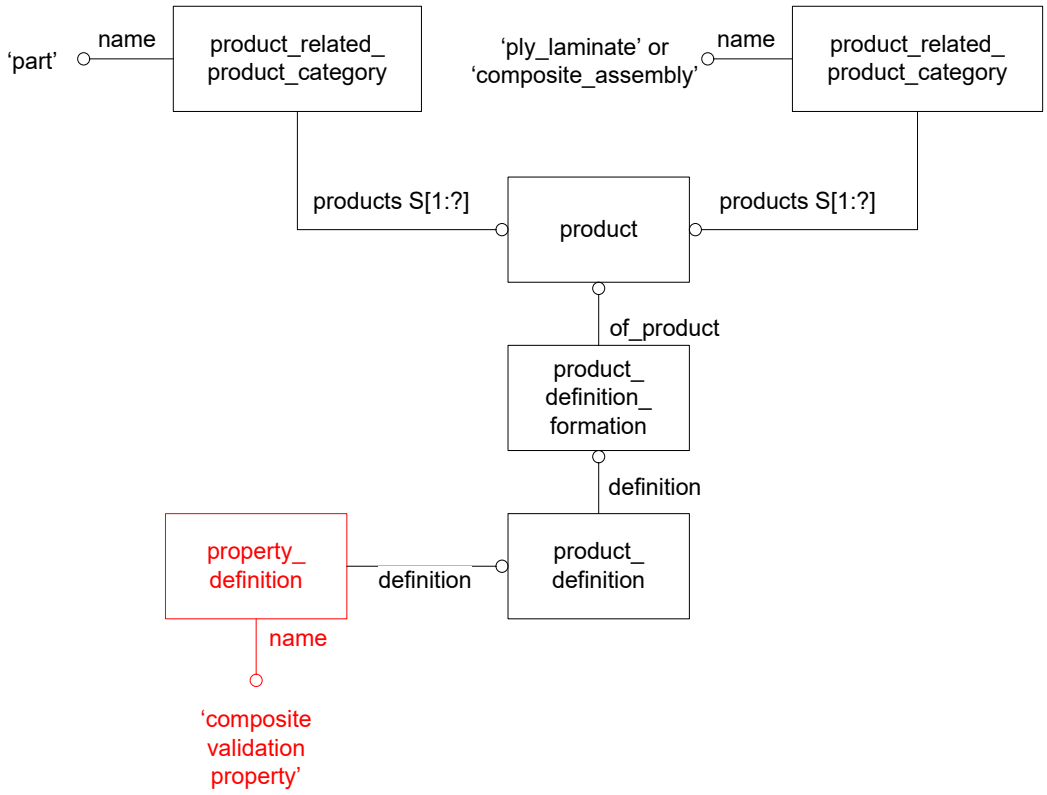

Figure 2: Composite Validation Properties at Part Level

Part21 Example:

```
#8=PRODUCT_RELATED_PRODUCT_CATEGORY('part',$,(#5));
#5=PRODUCT('Startmodel_CPD','','',(#2));
#6=PRODUCT_DEFINITION_FORMATION('',' ',#5);
#7=PRODUCT_CATEGORY('part','specification');
#10=PRODUCT_DEFINITION('',' ',#6,#3);
#11=PRODUCT_DEFINITION_SHAPE(' ',' ',#10);
#20=SHAPE_DEFINITION_REPRESENTATION(#11,#19);
#19=SHAPE_REPRESENTATION(' ',(#18),#16);
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
```

4.1.1 Number of Composite Tables

This validation property is the number of composite tables in the part.

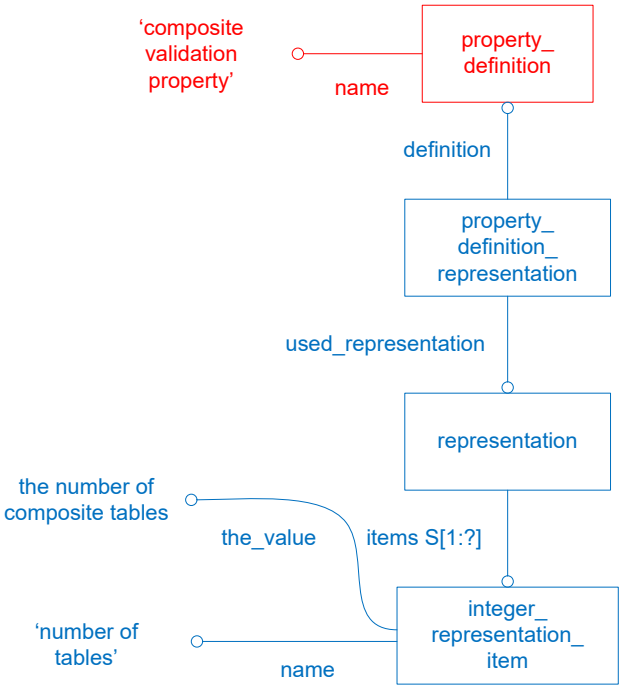

Figure 3: Definition of composite validation property for number of laminate tables

The value of the `integer_representation_item.name` in this instantiation shall be 'number of tables', and the number of tables shall be specified by a `integer_representation_item.the_value`.

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`integer_representation_item.name`	'number of tables'
`integer_representation_item.the_value`	The number of composite tables

Table 2: Attribute Values for the number of composite table

Note: The value of integer_representation_item has to be written as a REAL number, i.e. with trailing decimal point.

In general, values of type INTEGER are represented in a Part 21 file as integers, i.e. no decimal point. The case of integer_representation_item, however, is special. integer_representation_item is a subtype of int_literal, which is a subtype of literal_number. The latter defines the attribute the_value as of type NUMBER; int_literal then re-declares that to restrict it to INTEGER. Part 21 defines that in the case of a re-declared attribute, the original (more generic) type shall be used for implementation, here: NUMBER. And NUMBER maps to REAL in Part 21, hence the decimal point. So basically, integer_representation_item is an integer with an identity crisis, but from the context (name of the entity) it is clear that the decimal point shall be ignored.

For compatibility with existing data, integer_representation_item values without decimal points shall be supported as well on import.

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27041),#16);
#27041=INTEGER_REPRESENTATION_ITEM('number of tables',3.0);
```

4.1.2 Number of Sequences

This validation property is the total number of sequence in the part.

The STEP file structure is the same as for the number of composite table. The only difference is the suggested strings for the name attributes, which are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of sequences'
integer_representation_item.the_value	Total number of sequences in the part

Table 3: Attribute Values for the number of sequences

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27042),#16);
#27042=INTEGER_REPRESENTATION_ITEM('number of sequences',10.0);
```

4.1.3 Number of Plies

This validation property is the total number of plies in the part.

The STEP file structure is the same as for the number of composite table. The only difference is the suggested strings for the name attributes, which are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of plies'
integer_representation_item.the_value	Total number of plies in the part

Table 4: Attribute Values for the number of plies

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27043),#16);
#27043=INTEGER_REPRESENTATION_ITEM('number of plies',11.0);
```

4.1.4 Number of Cores

This validation property is the total number of cores in the part.

The STEP file structure is the same as for the number of composite table. The only difference is the suggested strings for the name attributes, which are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of cores'
integer_representation_item.the_value	The total number of cores in the part

Table 5: Attribute Values for the number of cores

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27044),#16);
#27044=INTEGER_REPRESENTATION_ITEM('number of cores',1.0);
```

4.1.5 Number of Materials

This validation property is the total number of materials in the part.

The STEP file structure is the same as for the number of composite table. The only difference is the suggested strings for the name attributes, which are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of materials'
integer_representation_item.the_value	Total number of materials in the part

Table 6: Attribute Values for the number of materials

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27045),#16);
#27045=INTEGER_REPRESENTATION_ITEM('number of materials',5.0);
```

4.1.6 Number of Orientations

This validation property is the number of different orientations used by the plies in the part.

The STEP file structure is the same as for the number of composite table. The only difference is the suggested strings for the name attributes, which are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of orientations'
integer_representation_item.the_value	Number of different orientation in the part

Table 7: Attribute Values for the number of orientations

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27046),#16);
#27046=INTEGER_REPRESENTATION_ITEM('number of orientations',5.0);
```

4.1.7 Number of Rosettes

This validation property is the number of different rosettes used by the plies in the part.

The STEP file structure is the same as for the number of composite table. The only difference is the suggested strings for the name attributes, which are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of rosettes'
integer_representation_item.the_value	Number of different rosettes in the part

Table 8: Attribute Values for the number of orientations

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27047),#16);
#27047=INTEGER_REPRESENTATION_ITEM('number of rosettes',5.0);
```

4.1.8 Centroid for all the Ply Shapes

This validation property is the centroids of all ply contours, not considering the surfaces.

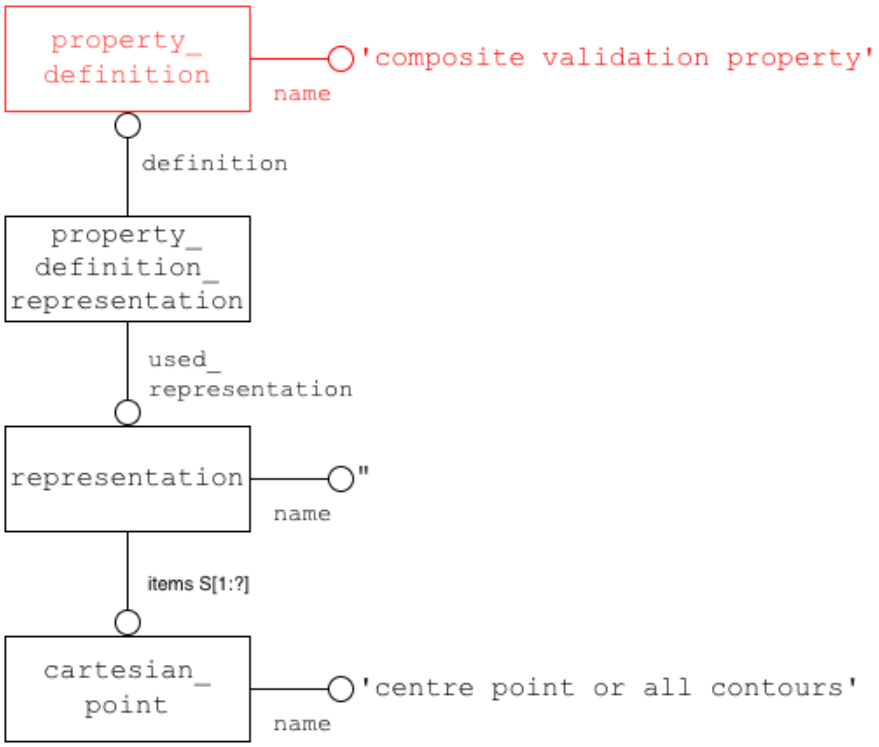

Figure 4: Ply Shapes Centroid

Attribute	Recommended value
property_definition.name	'composite validation property'
cartesian_point.name	'centre point of all contours'
cartesian_point.coordinates	The centroid of all ply contours

Table 9: Attribute Values for the sum of centorid of all ply contours.

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('ply centroid',(#27049),#16);
#27049=CARTESIAN_POINT('centre point of all plies',(-20.,-50.,0.));
```

4.1.9 Sum of all Ply Surface Areas

This validation property is the sum of all ply surface areas (for exact implicit ply representation).

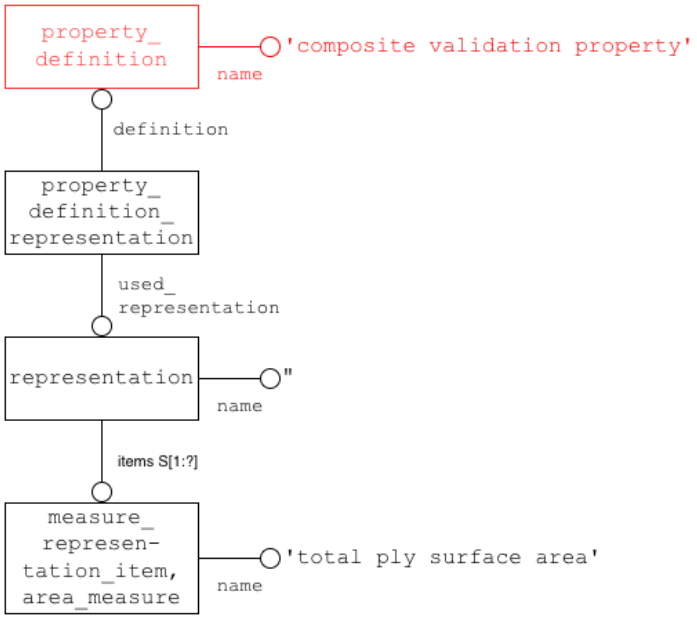

Figure 5: Ply Shape Surface Area

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	'total ply surface area'
measure_representation_item.area_measure	the sum of all ply surface areas

Table 10: Attribute Values for the sum of all ply surface areas

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27048),#16);
#27048=MEASURE_REPRESENTATION_ITEM('total ply surface
area',AREA_MEASURE(31177.2868069),#64) ;
```

4.1.10 Sum of Volume for the Cores in the Part

This validation property is the sum of volume of all Processed_core in the part.

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	'total core volume'
measure_representation_item.volume_measure	the sum value

Table 11: Attribute Values for the sum of volume for the cores in the part

4.1.11 Sum of Volume for Explicit Plies in the Part

This validation property is the sum of volume of all plies with an 3D explicit representation.

Attribute	Recommended value
property_definition.name	'composite validation property'
representation.name	''
measure_representation_item.name	'total ply volume'
measure_representation_item.volume_measure	the sum value

Table 12: Attribute Values for the sum of volume for explicit plies in the part

4.1.12 List of Orientation Values used in the Part

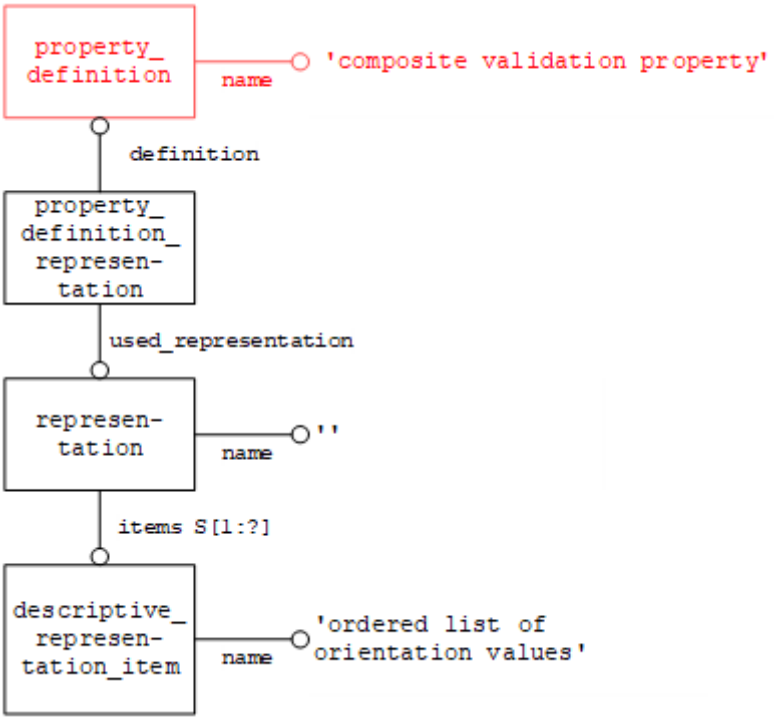

Figure 6: List of Orientation Values

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	'ordered list of orientation values'
descriptive_representation_item	Ordered (numerically ascending) list of orientation values used in the part as a concatenated string where values are separated by a blank space

Table 13: Attribute Values for ordered list of orientation values used in the part

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#26911),#16);
#26911=DESCRIPTIVE_REPRESENTATION_ITEM('ordered list of orientation
values','-45 -30 0 30 45 135');
```

4.1.13 List of Orientation Names used in the Part

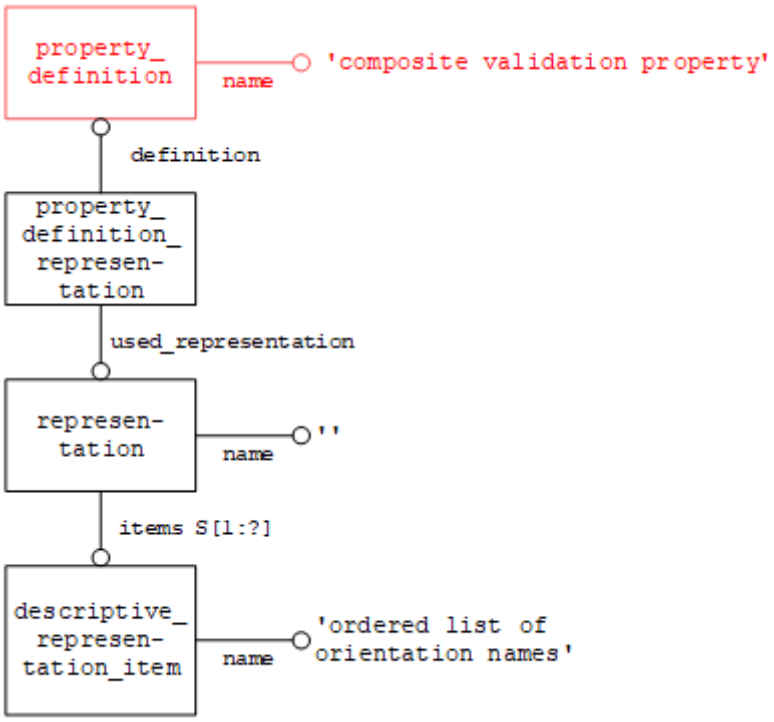

Figure 7: List of Orientation Names

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	'ordered list of orientation names'
descriptive_representation_item	Ordered (alphanumeric ascending) list of orientation names used in the part as a concatenated string where values are separated by a blank space

Table 14: Attribute Values for ordered list of orientation names used in the part

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#26912),#16);
#26912=DESCRIPTIVE_REPRESENTATION_ITEM('ordered list of orientation
names','0 0/90 45/135');
```

4.2 Composite Validation Properties at Laminate Table Level

For the validation properties associated to the laminate table, the `property_definition` shall be attached to the `composite_assembly_table` or `ply_laminate_table` of the laminate table.

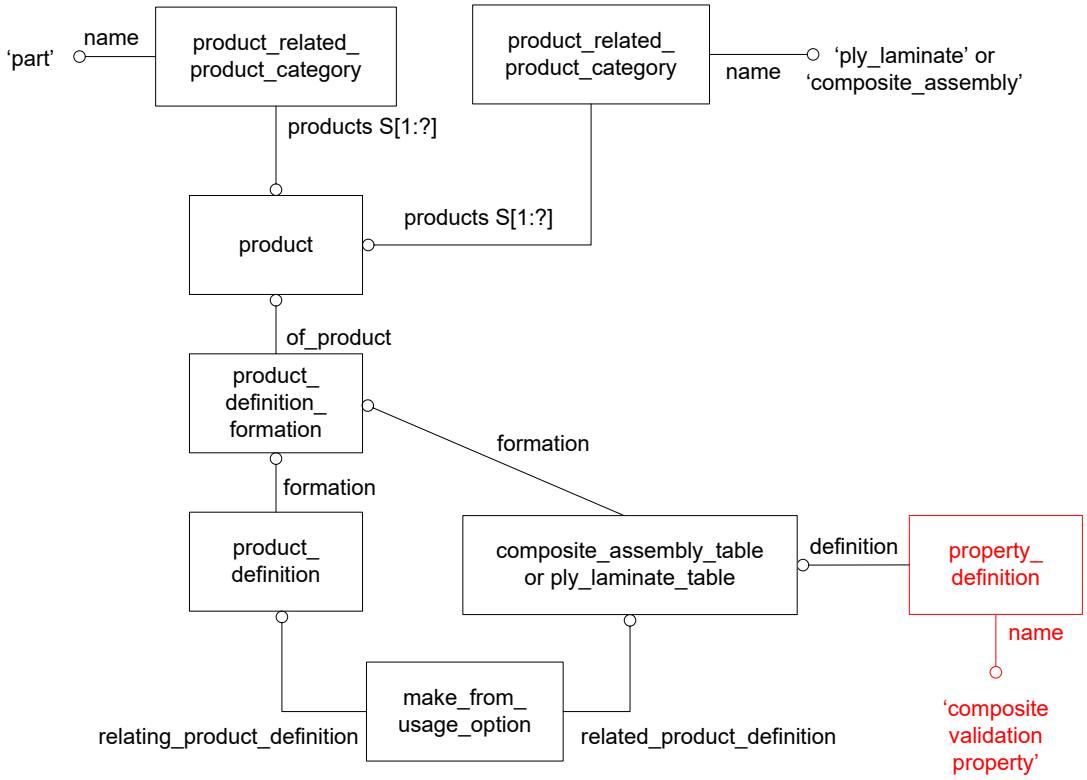

Figure 8: Composite Validation Properties at Laminate Table Level

Part21 Example:

```
#26300=COMPOSITE_ASSEMBLY_TABLE('01_PliesGroup-
UnderCore','',#6,#26293);
#26682=PROPERTY_DEFINITION('composite validation property',$,
#26300);
```

4.2.1 Number of composite sequences

This validation property is the total number of sequence in the laminate table. The suggested strings for the name attributes are:

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`integer_representation_item.name`	'number of sequences'
`integer_representation_item.the_value`	The total number of sequences in the laminate table

Table 15: Attribute Values for the number of sequences

4.2.2 Number of plies

This validation property is the total number of plies in the laminate table. The suggested strings for the name attributes are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of plies'
integer_representation_item.the_value	The total number of plies in the laminate table

Table 16: Attribute Values for the number of plies

4.2.3 Number of cores

This validation property is the total number of cores in the laminate table. The suggested strings for the name attributes are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of cores’
integer_representation_item.the_value	The total number of cores in the laminate table

Table 17: Attribute Values for the number of cores

4.2.4 Number of composite materials

This validation property is the total number of materials in the laminate table. The suggested strings for the name attributes are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of materials'
integer_representation_item.the_value	The total number of materials in the laminate table

Table 18: Attribute Values for the number of materials

4.2.5 Number of orientations

This validation property is the number of different orientations used by the plies in the laminate table. The suggested strings for the name attributes are:

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of orientations'
integer_representation_item.the_value	the number of different orientation in the part

Table 19: Attribute Values for the number of orientations

4.2.6 Ordered sequences name

This validation property is the ordered sequences name. In STEP, the `LIST` type allows storing ordered entities. The kind of `representation_item` which contains `LIST` is `row_representation_item`. The value of the `row_representation_item.name` in this instantiation shall be ‘ordered sequences per laminate table’, and the ordered sequence name shall be specified in the `item_element LIST`.

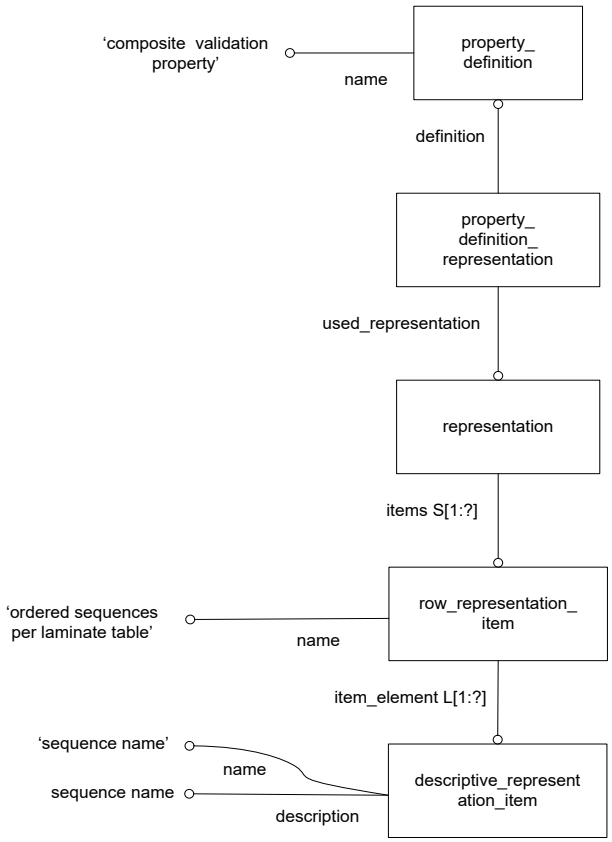

Figure 9: Definition of composite validation property for ordered list of sequences per table

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`row_representation_item.name`	‘ordered sequences per laminate table’
`descriptive_representation_item.item`	‘sequence name’
`integer_representa-tion_item.the_value`	The number of composite tables

Table 20: Attribute Values for the number of composite table

Part21 Example:

```
#26682=PROPERTY_DEFINITION('composite validation property',$,
#26300);
#26683=PROPERTY_DEFINITION_REPRESENTATION(#26682,#26681);
#26681=REPRESENTATION('',(#26901),#16);
#26901=ROW_REPRESENTATION_ITEM('ordered sequences per laminate
table',LIST_REPRESENTATION_ITEM( (#26902,#26903,#26904)));
#26902=DESCRIPTIVE_REPRESENTATION_ITEM('sequence name','A010');
#26903=DESCRIPTIVE_REPRESENTATION_ITEM('sequence name','A015');
#26904=DESCRIPTIVE_REPRESENTATION_ITEM('sequence name','A020');
```

4.2.7 Sum of ply surface areas

The value of `property_definition.name`, `representation.name` and `measure_representation_item.name` are:

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`measure_representation_item.name`	'total ply surface area'
`measure_representation_item,area_measure`	the sum of all ply surface areas

Table 21: Attribute Values for the sum of all ply surface areas

4.2.8 Centroids for all the ply shapes

The value of `property_definition.name`, `representation.name` and `measure_representation_item.name` are:

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`cartesian_point.name`	'centre point of all plies'
`cartesian_point.coordinates`	the centroid of all plies

Table 22: Attribute Values for the sum of centorid of all plies.

4.3 Composite validation properties at sequence level

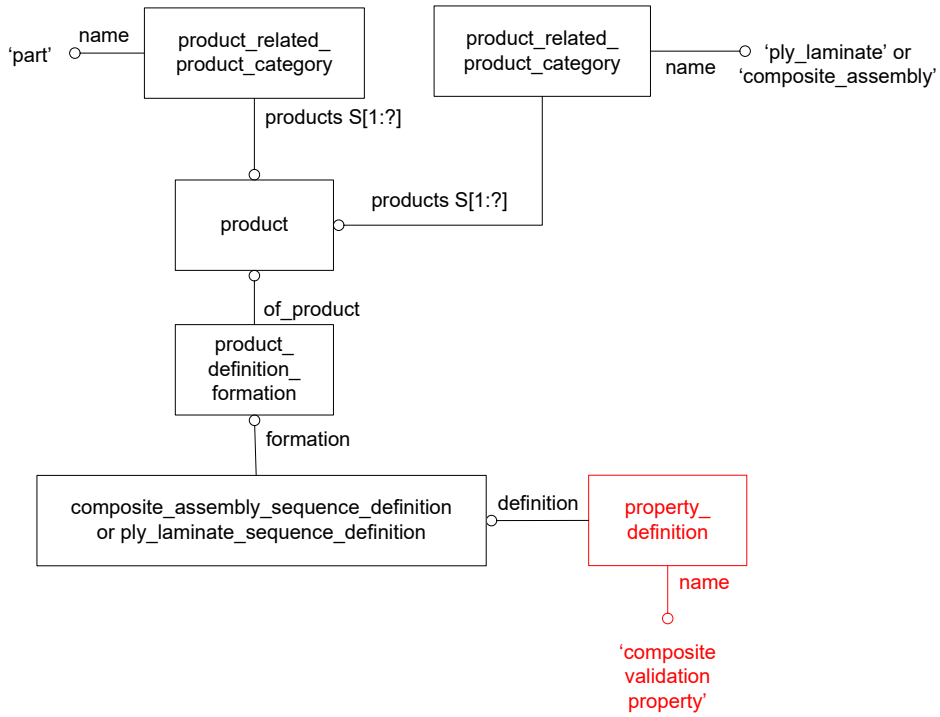

Figure 10: Composite Validation Properties at Sequence Level

Part21 Example:

```
#26314=COMPOSITE_ASSEMBLY_SEQUENCE_DEFINITION('A010','',#6,#26293);
#26393=PROPERTY_DEFINITION('composite validation
property',$,#26314);
```

4.3.1 Number of plies

The value of `property_definition.name` and `integer_representation_item.name` are:

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`integer_representation_item.name`	'number of plies'
`integer_representation_item.the_value`	The total number of plies in the sequence

Table 23: Attribute Values for the number of plies

4.4 Composite Validation Properties at Ply Level, at Core Level or at Ply Piece Level

For the composite validation properties at ply, core or ply piece level, the `property_definition` shall be attached to the `product_definition` of the ply, the core or the ply piece.

Figure 11: composite validation properties at ply level, at core level or at ply piece level

4.4.1 Volume

This validation property is for cores and explicit plies. It is the volume of the solid model for the core or for the explicit representation of the ply. The following entities, attributes and values shall be used:

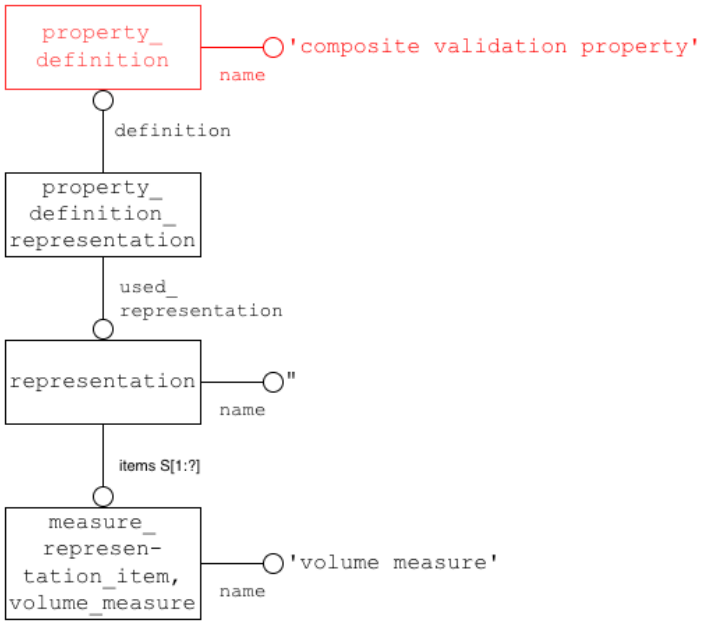

Figure 12: Definition of composite validation property for volume of the ply or core

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	'volume measure'
measure_representation_item,volume_measure	the volume measure

Table 24: Attribute Values for volume of the ply or core

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('volume',(#27049),#16);
#27049=MEASURE_REPRESENTATION_ITEM('volume measure',
VOLUME_MEASURE(376922.561622), #26272);
```

4.4.2 Centroid

This validation property is for cores and explicit plies. A centroid is the center of volume of the geometric solid model for the core or for the explicit representation of the ply. The following entities, attributes and values shall be used:

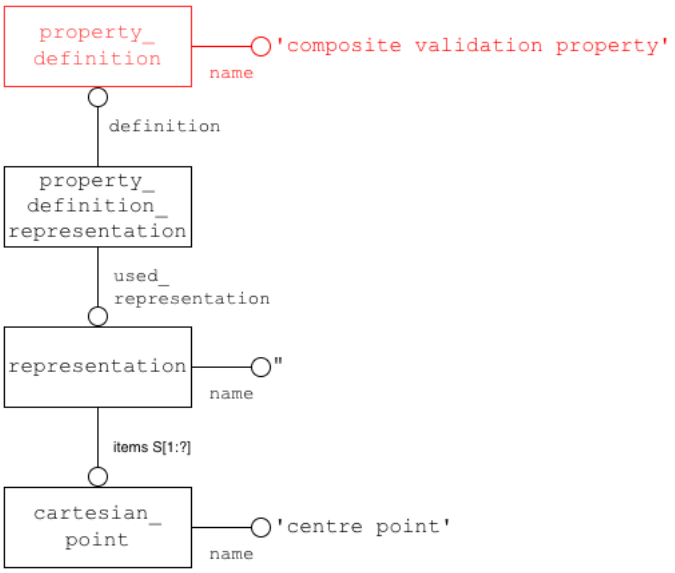

Figure 13: Composite Validation Property for the Centroid of the Ply or Core

Attribute	Recommended value
property_definition.name	'composite validation property'
cartesian_point.name	'centre point'
cartesian_point	the centroid

Table 25: Attribute Values for centroid of the ply or core

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('centroid',(#27049),#16);
#27049=CARTESIAN_POINT('centre
point',(1300.0000445,499.999984776,85.7435045689));
```

4.4.3 Surface Area

This validation property is for cores and explicit plies. Surface area specifies the area measurement of the surface of the entire solid for the core or for the explicit representation of the ply.

The following entities, attributes and values shall be used:

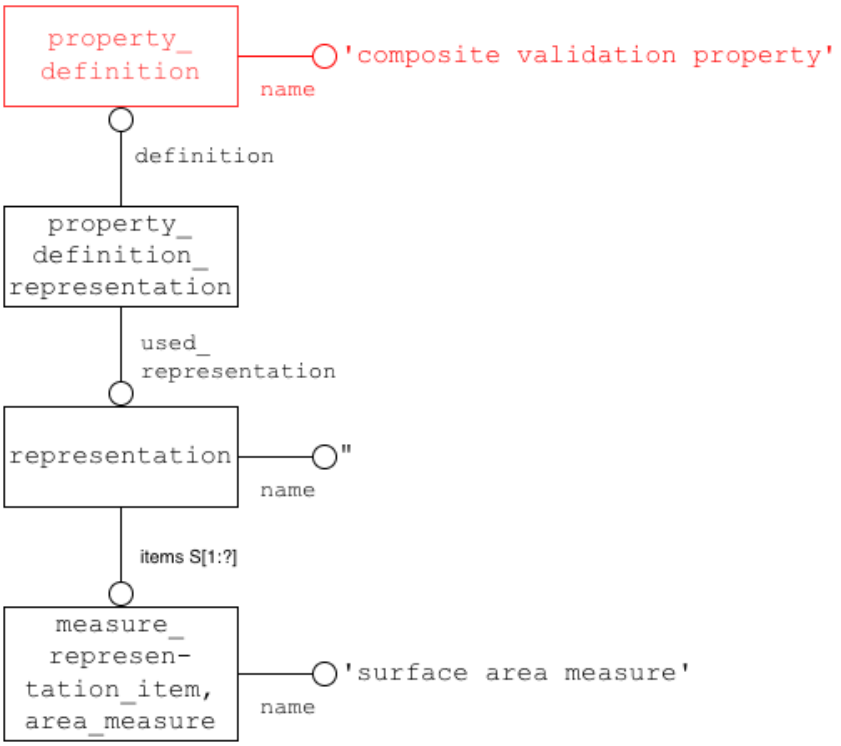

Figure 14: Definition of composite validation property for the surface area of the ply or core

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	'surface area measure'
measure_representa- tion_item,area_measure	the surface area

Table 26: Attribute Values for surface area of the ply or the core

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('centroid',(#27049),#16);
#27049=MEASURE_REPRESENTATION_ITEM('area measure',
AREA_MEASURE(81361.3229339),#3003);
```

4.4.4 Geometric Boundary Curve Length

This validation property is for implicit shape representation of plies or ply piece. It is the total length of the curves that define the contours of the ply.

The following entities, attributes and values shall be used:

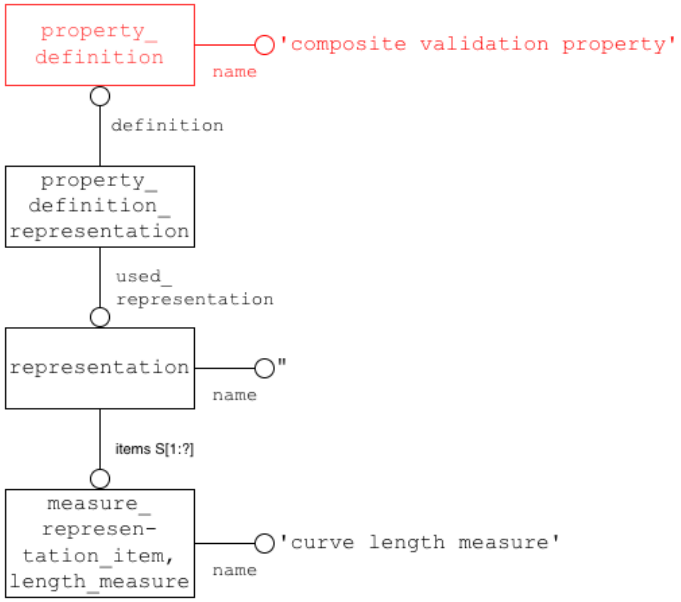

Figure 15: Composite Validation Property for the Geometric Boundary Curve Length of the Ply or Ply Piece

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	‘curve length measure’
measure_representa- tion_item.length_measure	the length

Table 27: Geometric boundary curve length of the ply or the ply piece

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('centroid',(#27049),#16);
#27049=MEASURE_REPRESENTATION_ITEM('curve length measure',
LENGTH_MEASURE(5524.94214762),#12)
```

4.4.5 Geometric Boundary Curve Centroid

This validation property is for implicit shape representation of plies or ply piece. It is the center of the curves that define the contours of the ply. The following entities, attributes and values shall be used:

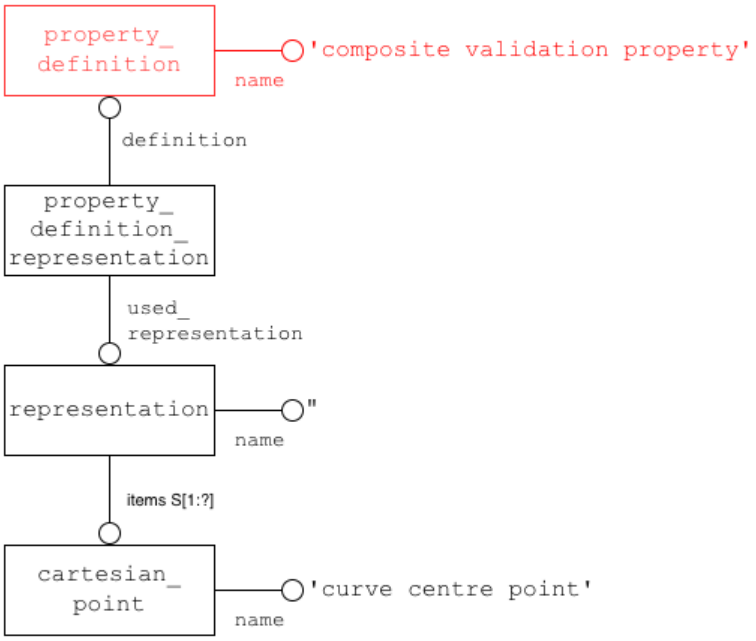

Figure 16: Composite validation property for the curve centroid of the contours of the ply or ply pieces

Attribute	Recommended value
property_definition.name	'composite validation property'
cartesian_point.name	'curve centre point'
cartesian_point	the centroid

Table 28: Attribute Values for centroid of the the curve centroid of the contours of the ply or ply pieces

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('curve centroid',(#27049),#16);
#27049=CARTESIAN_POINT('curve centre point',
(1300.0000445,499.999984776,85.7435045689));
```

4.4.6 Number of Ply Pieces per Ply

This validation property is for plies that are constitute by ply pieces. It is a aheck the total number of ply pieces per ply

.

Figure 17: Definition of composite validation property for number of laminate tables

For the validation of the number of ply pieces of each ply, the `property_definition` shall be attached to the `product_definition` of the ply. The value of `property_definition.name` that specifies the ply piece count validation property shall be 'composite validation property'. The value of the `integer_representation_item.name` in this instantiation shall be 'number of ply pieces per ply', and the number of ply pieces shall be specified by `integer_-representation_item.the_value`.

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`integer_representation_item.name`	'number of ply pieces per ply'
`integer_representa-tion_item.the_value`	The total number of plies piece in the ply

Table 29: Attribute Values for the number of plies

Part21 Example:

```
#27039=PROPERTY_DEFINITION('composite validation property',$,#10);
#27040=PROPERTY_DEFINITION_REPRESENTATION(#27039,#27038);
#27038=REPRESENTATION('',(#27043),#16);
#27043=INTEGER_REPRESENTATION_ITEM('number of ply pieces per ply
',4.0);
```

4.4.7 Number of facets

This validation property is for explicit representation of plies as 3D tessellated geometry.

This validation property is the number of facet for each plies.

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`integer_representation_item.name`	'number of facets'
`integer_representation_item.the_value`	The number

Table 30: Attribute Values for the number of facet

4.5 Composite validation properties at rosette level

For the composite validation properties at rosette level, the `property_definition` shall be attached to an `item_identified_representation_usage` (IIRU). The attribute `definition` of the IIRU references the `property_definition` that defines the `reinforcement_orientation_basis` (`ROB`). The attribute `used_representation` shall reference the `ROB`. And the attribute `identified_item` reference the `cartesian_11`, `curve_11`, `cylindrical_11` or `polar_11`.

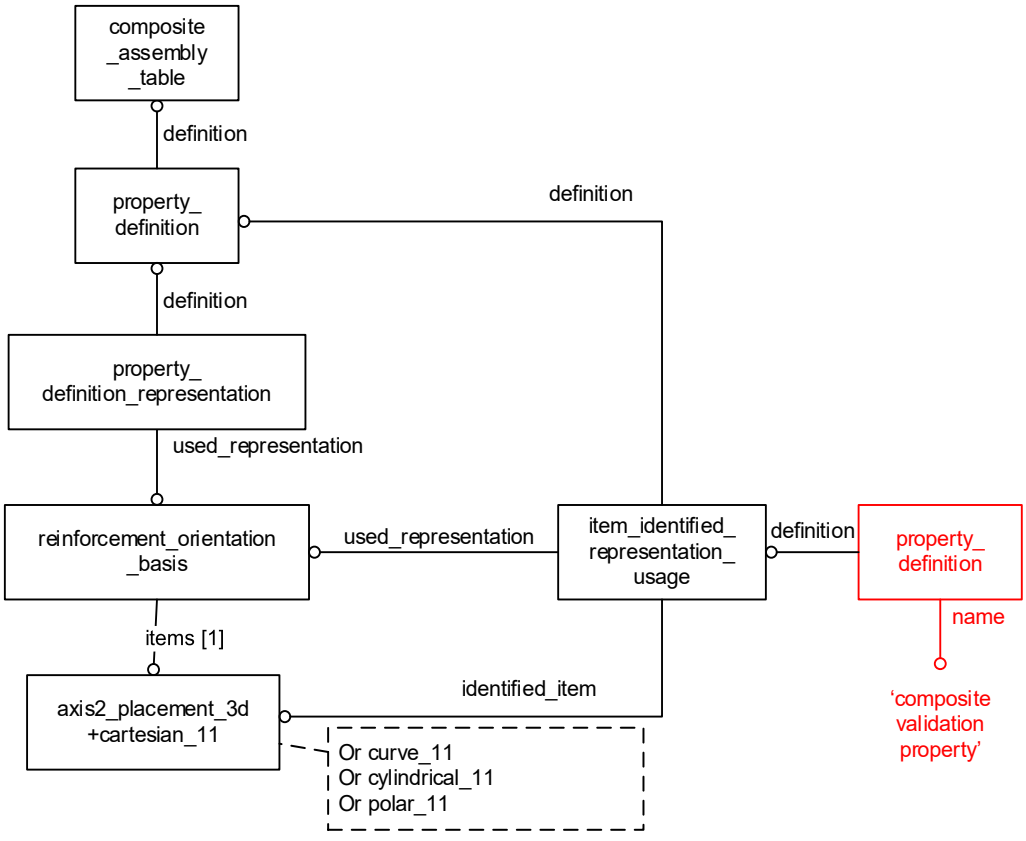

Figure 18: composite validation properties at rosette level

Part21 Example:

```
#1=COMPOSITE_ASSEMBLY_TABLE($,$,$,$);
#2=PROPERTY_DEFINITION($,$,#1);
#3=PROPERTY_DEFINITION_REPRESENTATION(#2,#4);
#4=REINFORCEMENT_ORIENTATION_BASIS($,(#8),$);
#6=PLY_ORIENTATION_ANGLE($,$,#4,#7);
#7=PLY_ANGLE_REPRESENTATION($,$,$);
#8=(AXIS2_PLACEMENT_3D($,$)CARTESIAN_11()GEOMETRIC_REPRESENTA-
TION_ITEM()PLACEMENT($)REPRESENTATION_ITEM($));
#9=ITEM_IDENTIFIED_REPRESENTATION_USAGE(' ',$,#2,#4,#8);
#5=PROPERTY_DEFINITION('composite validation property',$,#9);
```

4.5.1 Number of Plies

This validation property is the total number of plies that used this rosette.

Attribute	Recommended value
property_definition.name	'composite validation property'
integer_representation_item.name	'number of plies'
integer_representation_item.the_value	The number

Table 31: Attribute Values for the number of plies

4.5.2 Geometric Boundary Length

This validation property is the sum of the geometric boundary length of the plies where the rosette is used.

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	‘total boundary curve length’
measure_representa- tion_item.length_measure	the length

Table 32: Attribute Values for the boundary length

4.5.3 Rosette Guided by a Curve

4.5.3.1 Curve Length

This validation property is the Curve length of the guide curve for rosette type curve_11.

Attribute	Recommended value
property_definition.name	'composite validation property'
measure_representation_item.name	‘guide curve length’
measure_representa-tion_item.length_measure	the length

Table 33: Attribute Values for the curve length

4.5.3.2 Curve Centroid

This validation property is the Curve centroid of the guide curve for rosette type curve_11.

Attribute	Recommended value
property_definition.name	'composite validation property'
cartesian_point.name	‘guide curve centre point’
cartesian_point	the centroid

Table 34: Attribute Values for the curve centroid

4.6 Composite Validation Properties at Material Level

For the composite validation properties at material level, the property_definition shall be attached to the product_definition of the material.

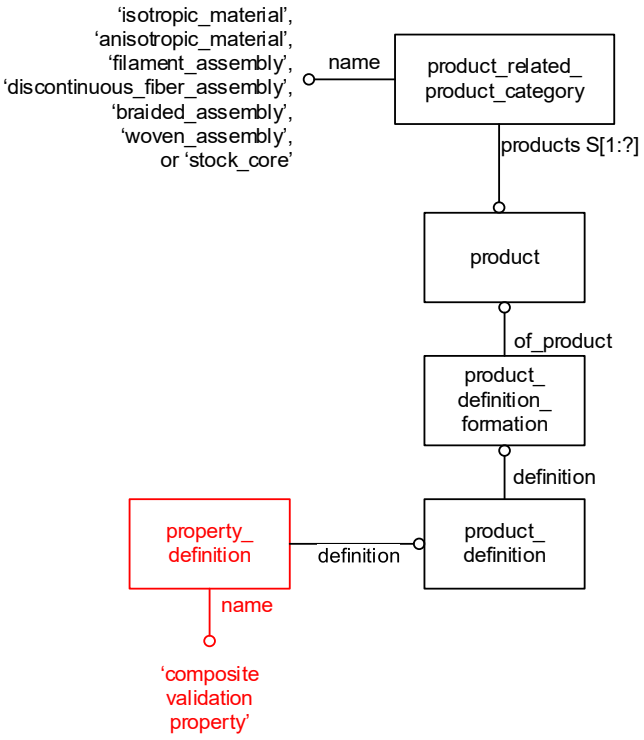

Figure 19: composite validation properties at material level

4.6.1 Sum of Ply Area by Material

This validation property is the sum of surfaces areas (for exact implicit ply representation) for the plies using this material.

Attribute	**Recommended value**
`property_definition.name`	'composite validation property'
`measure_representation_item.name`	‘total ply surface area’
`measure_representation_item.area_measure`	the sum of ply surfaces areas

Table 35: Attribute Values for the sum of ply volume by material

4.6.2 Sum of Ply Volume by Material

This validation property is the sum of volume for the plies using this material and with an 3D explicit representation.

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`measure_representation_item.name`	’total ply volume’
`measure_representation_item.volume_measure`	the sum value

Table 36: Attribute Values for the sum of volume for explicit plies in the part

4.7 Composite Validation Properties at Core Sample Level

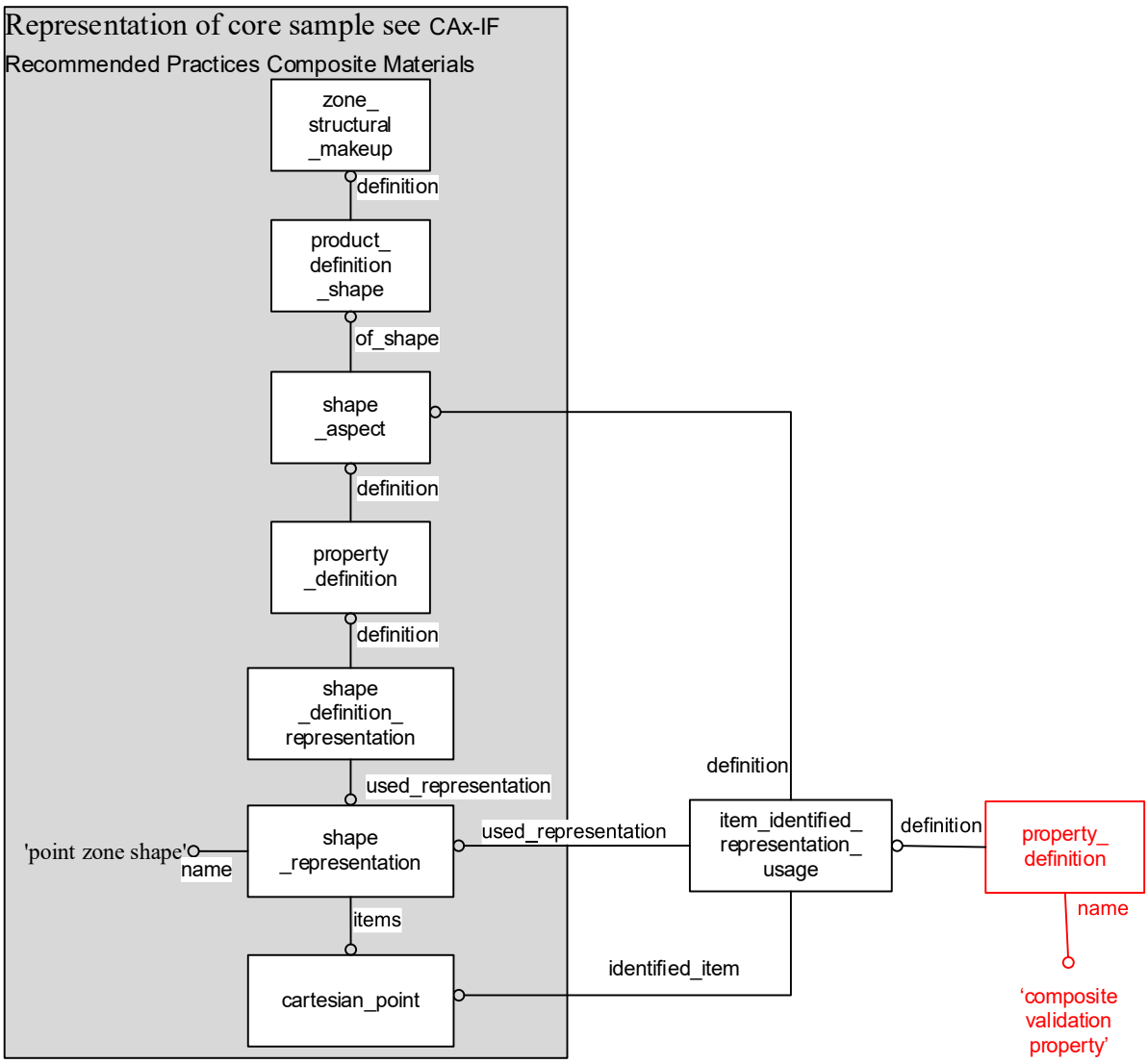

Figure 20: Composite Validation Properties at Core Sample Level

4.7.1 Number of Plies

This validation property is the total number of plies that use this rosette.

Attribute	Recommended value
`property_definition.name`	'composite validation property'
`integer_representation_item.name`	'number of plies'
`integer_representation_item.the_value`	The number

Table 37: Attribute Values for the number of plies

5 Summary of Imposed Attribute Values

The following constraints on attribute values are imposed by this recommended practice:

Section	Validation Property for	VP Level	REPRESENTATION_ITEM.NAME	REPRESENTATION_ITEM Subtype
4.1.1	Part	1	'number of tables'	integer_representation_item
4.1.2	Part	1	'number of sequences'	integer_representation_item
4.1.3	Part	1	'number of plies'	integer_representation_item
4.1.4	Part	1	'number of cores'	integer_representation_item
4.1.5	Part	1	'number of materials'	integer_representation_item
4.1.6	Part	1	'number of orientations'	integer_representation_item
4.1.7	Part	1	'number of rosettes'	integer_representation_item
4.1.8	Part	1	'centre point of all contours'	cartesian_point
4.1.9	Part	1	'total ply surface area'	measure_representation_item, area_measure
4.1.10	Part	1	'total core volume'	measure_representation_item, volume_measure
4.1.11	Part	1	'total ply volume'	measure_representation_item, volume_measure
4.1.12	Part	1	'ordered list of orientation values'	descriptive_representation_item
4.1.13	Part	1	'ordered list of orientation names'	descriptive_representation_item
4.2.1	Laminate table	2	'number of sequences'	integer_representation_item
4.2.2	Laminate table	2	'number of plies'	integer_representation_item
4.2.3	Laminate table	2	'number of cores'	integer_representation_item
4.2.4	Laminate table	2	'number of materials'	integer_representation_item
4.2.5	Laminate table	2	'number of orientations'	integer_representation_item

Section	Validation Property for	VP Level	REPRESENTATION_ITEM.NAME	REPRESENTATION_ITEM Subtype
4.2.6	Laminate table	2	‘ordered sequences per laminate table’	row_representation_item
4.2.7	Laminate table	2	'total ply surface area'	measure_representation_item, area_measure
4.2.8	Laminate table	2	'centre point of all plies'	cartesian_point
4.3.1	Sequence	2	'number of plies'	integer_representation_item
4.4.1	Ply, core, ply piece	2	‘volume measure’	measure_representation_item, volume_measure
0	Ply, core, ply piece	2	‘centre point’	cartesian_point
0	Ply, core, ply piece	2	‘surface area measure’	measure_representation_item, area_measure
0	Ply, core, ply piece	2	‘curve length measure’	measure_representation_item, length_measure
0	Ply, core, ply piece	2	‘curve centre point’	cartesian_point
4.4.6	Ply	2	‘number of ply pieces per ply’	integer_representation_item
4.4.7	Ply	2	‘number of facets’	integer_representation_item
4.5.1	Rosette	2	'number of plies'	integer_representation_item
4.5.2	Rosette	2	‘total boundary curve length’	measure_representation_item, length_measure
4.5.3.1	Rosette	2	‘guide curve length’	measure_representation_item, length_measure
4.5.3.2	Rosette	2	‘guide curve centre point’	cartesian_point
4.6.1	Material	2	‘total ply surface area’	measure_representation_item, area_measure
4.6.2	Material	2	’total ply volume’	measure_representation_item, volume_measure
4.7.1	Point Zone	2	'number of plies'	integer_representation_item

Table 38: Overview on imposed attribute values

Annex A Document References

A.1 Recommended Practices for Composite Materials

Defines the implementation recommendations for the composite materials the validation properties in this document are for.

- Version 4.3, 2 October 2025
- https://www.mbx-if.org/home/wp-content/uploads/2025/10/Rec_Pracs_Composites_V4.3.pdf

A.2 Recommended Practices for Geometric Validation Properties

Defines the validation properties for regular (B-Rep) part geometry and provides recommendation on how to evaluate the validation properties on import.

- Version 4.6, 21 April 2023
- https://www.mbx-if.org/home/wp-content/uploads/2024/05/rec_prac_gvp_v46.pdf

Annex B Availability of Implementation Schemas

B.1 AP203 Edition 2

The longform EXPRESS schema for the second edition of AP203 (2011) can be retrieved from:

- https://www.mbx-if.org/home/wp-content/uploads/2024/07/part403ts_wg3n2635mim_lf.zip

Note that the first edition of AP203 is no longer support in these Recommended Practices.

B.2 AP242 Edition 2

The longform EXPRESS schema for the second edition of AP242 (2019) can be retrieved from:

- https://www.mbx-if.org/home/wp-content/uploads/2024/07/ap242ed2_mim_lf_v1.101.zip

B.3 AP242 Edition 4

The longform EXPRESS schema for the third edition of AP242 (2025) can be retrieved from:

- https://standards.iso.org/iso/ts/10303/-442/ed-7/tech/express/mim_lf.exp