Test Suite for the CAx Implementor Forum Round 34J

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1 Introduction

This document describes the suite of test cases to be used for the thirty-fourth round of testing of the CAx Implementor Forum (CAx-IF). The CAx-IF is a joint testing forum organized and facilitated by PDES, Inc., and the ProSTEP iViP Association. The test rounds of the CAx-IF concentrate primarily on testing the interoperability and conformance of STEP processors based on AP203, AP214, and AP242.

The test rounds in general combine testing of synthetic and production models. Production models will in most cases be provided by the member companies of the organizations PDES, Inc. and ProSTEP iViP Association. When production models are not available from the member companies, “production-like” models will be solicited from the various CAx-IF participants.

This test suite includes synthetic models for testing the following capabilities: Product Manufacturing Information (PMI), both as Graphic Presentation and as Semantic Representation, Geometric Validation Properties, and 3D Tessellated Geometry.

Production models are provided for assemblies and piece parts. The basis for the production test cases is native CAD models. Each test case therefore originates from a single CAD system, and the set of test cases to be pre-processed (converted to STEP files) is unique for each CAD system. After pre-processing, the resulting STEP files are then to be imported/post-processed/read in by the rest of the participants.

1.1 Functionality tested in this round

Functionality tested in this round relates to:

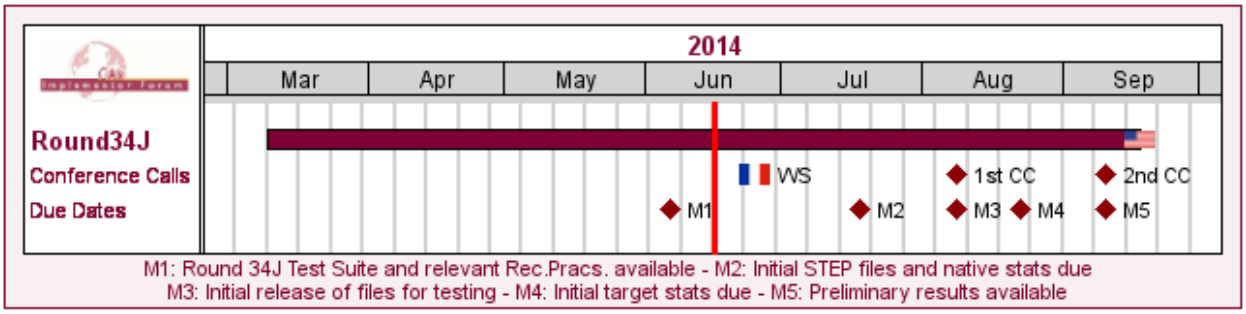
- **Product Manufacturing Information (PMI)** describes the capability to embed information about dimensions, tolerances and other parameters which are necessary input for the manufacturing and measuring of the part from the 3D model. In Round34J, the focus will be on the two approaches for the transfer of PMI in the 3D model:
    - “Tessellated Presentation” refers to breaking down each annotation into tessellated elements as supported by AP242, and exchanging them as geometry. This preserves the exact shape of the annotation, but is human readable only. The test will include section views as well.
    - “Semantic Representation” refers to the intelligent transfer of PMI data in an associative and re-usable way. This scenario aims towards downstream usage and later modifications of the model. The data is machine-readable, but not necessarily visible in the 3D model. However, the test also includes additional presentation data, which can be linked to the corresponding PMI representation.
- **Geometric Validation Properties** is a mechanism to allow the exchange of geometric properties and their assignment to geometric representations for the purposes of data exchange validation. This includes information about volume, area, centroid, and curves. In Round34J, the focus will be on the additional validation properties for surface data, as well as on the recently agreed optimized implementation structure.
- **Tessellated Geometry** is a simplified representation for the part shape, where the geometry is not given as an exact B-Rep model, but as a collection of simple planar faces (triangles) which can be easily and efficiently created and applied in specific use cases. The scope includes the watertight tessellation format (WTF) and compressed STEP files.
- **Production Models** will be included in this round of testing if available, in addition to the synthetic models for the above capabilities.

1.2 General testing instructions for this round

The general procedures for communication of models and statistics are outlined in a separate document 'General Testing Instructions'. The general instructions can be retrieved from the CAx Implementor Forum web sites. The latest version is v1.11, dated November 15, 2013.

1.3 Testing Schedule

The following schedule has been agreed on for Round 34J:



CAx-IF Round34J Schedule

Date	Action
6 Jun 2014 (Fri)	Round 34J Test Suite and relevant Rec.Pracs. available
25 Jun 2014 (Wed)	CAx-IF Technical Workshop in Toulouse, France
18 Jul 2014 (Fri)	Initial STEP files and native stats due
8 Aug 2014 (Fri)	1st CAx-IF Round34J Conference Call / Initial release of files for testing
22 Aug 2014 (Fri)	Initial target stats due
10 Sep 2014 (Wed)	Preliminary results available / 2nd CAx-IF Round34J Conference Call
15 Sep 2014 (Mon) - 17 Sep 2014 (Wed)	CAx-IF Round34J Review Meeting in Charleston, SC, USA

Figure 1: CAx-IF Round34J Schedule

The CAx-IF Technical Workshop will be held in conjunction with a LOTAR meeting. Conference calls and web sessions will also be available.

The CAx-IF R34J Review meeting will take place in conjunction with the PDES, Inc. Fall Offsite meeting and a LOTAR workshop. In addition, conference calls and web sessions will be available for those not attending the meeting to dial in.

1.4 Copyrights on test cases

None of the production test cases which were provided by the PDES, Inc. and ProSTEP iViP member companies are released for any purpose. The test cases can be freely distributed among the CAx-IF members, and can be used for any purposes that are related to CAx-IF testing (i.e. testing, documentation of testing efforts), as long as a reference to the originating company is made.

The test cases must not be used for any purposes other than CAx-IF testing or outside of PDES, Inc. and ProSTEP iViP. Test cases provided by the LOTAR project for testing of specific capabilities are applicable to the same restrictions and may not be used outside LOTAR or CAx-IF.

2 Synthetic Test Case Specifications

2.1 Model TP3: PMI Tessellated Presentation

All information about this test case can also be viewed in CAESAR on its Information page.

2.1.1 Motivation

Product Manufacturing Information is required for a number of business use cases in the context of STEP data exchange. Among others, they are a prerequisite for long-term data archiving. In addition, the PMI can be used to drive downstream applications such as coordinate measuring and manufacturing.

For documentation and long-term archiving purposes, the Polyline Presentation approach was suggested and developed by the LOTAR project group. Based on this approach, it was proposed to use the new data model for 3D Tessellated Geometry available in AP242 DIS for a more efficient implementation of graphic PMI annotations, especially in the case of filled characters.

2.1.2 Approach

The files have to be in AP242 IS format (schema version 1.28 or later). The recommended schema version to use is v1.36 (IS schema), which can be found in the CAx-IF member area under “Information on Round 34J of Testing”.

Applicable Recommended Practices:

- “Current Working Draft of the Recommended Practices for PMI Representation & Presentation (v3.8)” (dated February 18, 2014)

The document is available in the CAx-IF member area, under “Information on Round 33J of Testing”.

2.1.3 Testing Instructions

A dedicated test model has been developed by Alain Roche, which is prepared for the definition of Section Views. All members participating in this test are asked to add the scope they support to the model as described below.

2.1.3.1 Test Model

A dedicated test model has been developed in Round28J, originally for the testing of PMI Polyline Presentation. The model is continued to be used for the testing of PMI Tessellated Presentation and Saved Views. It is provided in the member area of the CAx-IF homepage, under “Information on Round28J of Testing,” in two formats:

- A native CATIA V5 model (*.CATPart)
- A STEP file containing the geometry (*.stp) for re-creation of the model with PMI and views in other CAD systems

The detailed description of the PMI and Views to be added can be found in Annex A of the Round28J Test Suite document.

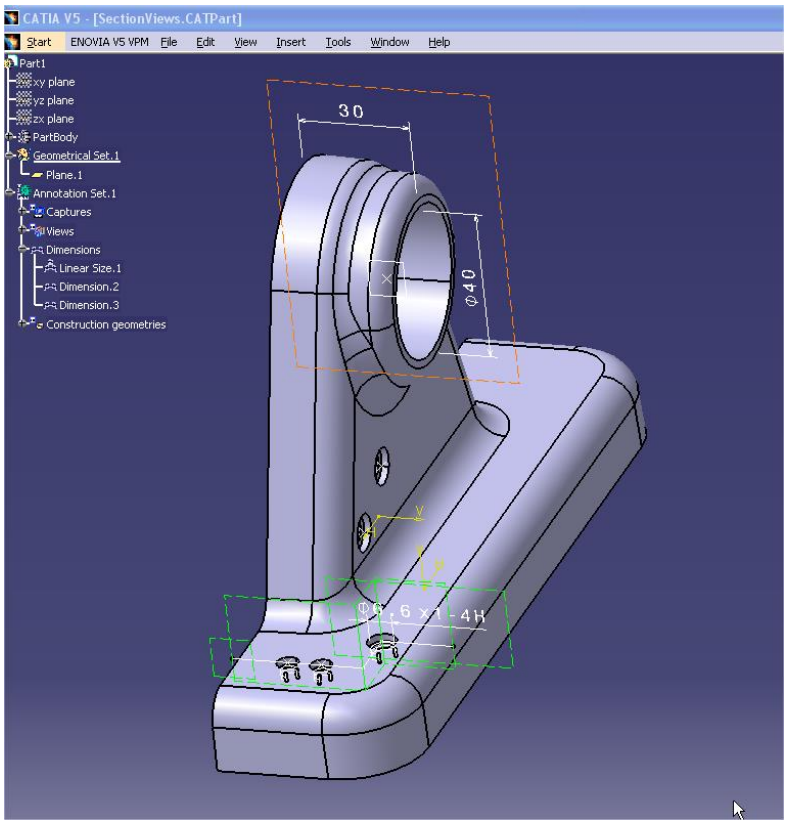


Figure 2: Illustration of the TP3 Model

2.1.3.2 Test Model Configuration

The following functionality shall be included in the test file provided for this round of testing, as far as it has been implemented by the CAx-IF participants and is described in the Recommended Practices:

- Tessellated Presentation – include the PMI elements as tessellated annotations. Stroked, outline and filled fonts (and combinations) are allowed, as well as styling of the annotations (colors).
- Definition of "Saved Views" – as far as supported, include at least one saved view in the model, which contains a subset of annotations in the file, and provides a pre-defined position of the model in the design space. Further recommendations:
  - One of the views should be a "detail view", which does not show the entire model but only part of it by zooming in.
  - For each view, a screenshot showing the model layout (displayed elements, orientation, zoom) shall be provided. **Note** that it is possible to attach several screenshots to one set of statistics in CAESAR. The name of the view shall be given as description for the screenshot.
  - Both "basic" and "advanced" view implementation is allowed
  - As far as supported, the section views as defined in Annex A of the Round28J Test Suite shall be added to the model. Screenshots for these views are essential.

- Cross-highlighting of annotations and annotated shape – if supported, include in the STEP file the information necessary to maintain the association between annotations and the annotated shape elements in a way, that after import, when highlighting an annotation, the shape elements annotated by it are highlighted too, and vice versa.
- PMI Validation Properties for Tessellated Presentation – as far as supported, include the validation properties in the files, and evaluate these after import:
    - "Number of Segments"
    - "Tessellated Curve Length"
    - "Tessellated Centre Point"
    - "Number of Facets"
    - "Tessellated Surface Area"
    - "Equivalent Unicode String"
    - "Affected Geometry"

Note that for the creation of the Equivalent Unicode String, the mapping as defined by the "Unicode String Project" report (Revision J) shall be used. This document is available in the member areas of the CAx-IF homepages, under "Relevant LOTAR Documents for CAx-IF Testing".

Note that for the PMI validation properties, the new optimized implementation structure for validation properties can be used. This is currently defined in section 4.10 of the "Recommended Practices for Geometric and Assembly Validation Properties" (Release 4.1, dated June 16, 2014), which can be found in the CAx-IF member areas under "Information on Round 34J of Testing".

2.1.3.3 Statistics

For each STEP file exported or imported for the TP3 test case, vendors must submit the corresponding statistics to CAESAR. To do so, go to the [TP3 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

View-related Statistics

Several of the Statistics for this test case are view-related (e.g. number of annotations, positioning/ scaling, section view). The statistics cannot evaluate this for all views in the model. Hence, the idea is to select one specific (interesting) view on export and publish its name in the "Saved View" field of the statistics. Then, fill in the other view-related statistics with the values as valid for this particular view. After import, select the view with the name given in the native statistics and again provide the values valid for this view.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec.Pracs. definitions are fulfilled), 'limited support' (meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a STEP file, report the results found after processing the file as described in the table below.

Screenshots

For each Saved View in the model, provide one screenshot which illustrates the layout (displayed geometry and annotation, model orientation, and zoom factor). Give the name of the view as the description of the screenshot.

Note that in order to count the PMI elements for the statistics, per agreement during the Round 22J Review Meeting, the names of the `tessellated_geometric_set` shall be considered.

See section “Indicating the Presented PMI Type” in the PMI Recommended Practices for details.

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘TP3’
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, enter 'stp'
dimension	The number of dimensions processed
datums	The number of datums processed
datum_targets	The number of datum targets processed
tolerances	The number of tolerances processed
labels	The number of labels processed
saved_view	The name of the Saved View which is the basis for the view-related statistics
view_annot	The number of annotations included in the specified saved view.
view_pos	pass/fail, whether the model orientation and zoom factor stored for the Saved View could be restored successfully.
section_view	pass/fail, whether the section view (clipping plane and visible portion of the model) was transferred correctly.
highlight	all/partial/none – whether the cross-highlighting for annotations and annotated shape elements works correctly
tess_pmi_area	all/partial/none – whether the surface area of the Tessellated PMI annotations was validated successfully for all, some or none of the given annotations.
tess_pmi_clength	all/partial/none – whether the total length of segments per Tessellated PMI annotation was validated successfully for all, some or none of the given annotations.
tess_pmi_c	all/partial/none – whether the centroids of the Tessellated PMI annotations were validated successfully for all, some or none of the given annotations.
eq_unicode	all/partial/none - if the encoding of the equivalent Unicode string was correct for all, some or none of the given annotations.
valid_tess_vp	pass/fail, is the instantiation of the validation properties for Tessellated Geometry in the STEP file per the recommended practices?
affected_geo	all/partial/none – whether the affected geometry could be validated correctly for all, some or none of the PMI statements in the model.
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.2 Model SP3: Semantic PMI Representation

All information about this test case can also be viewed in CAESAR on its Information page.

2.2.1 Motivation

Product Manufacturing Information is required for a number of business use cases in the context of STEP data exchange. Among others, they are a prerequisite for long-term data archiving. In addition, the PMI can be used to drive downstream applications such as coordinate measuring and manufacturing.

PMI Representation relates to the capability to intelligently store the PMI data in the STEP file in a computer-interpretable way, so that it can be re-used for model redesign or downstream applications. Though the definition of the data is complete, it is by itself not visible in the 3D model.

Additional presentation capabilities are needed to display the data in a way that it is visible to the user in the 3D model. Addition of presentation is data is optional in the SP3 test case.

2.2.2 Approach

The approach to be used is described in the latest working draft (at least version 3.8, dated February 18, 2014) of the “Recommended Practices for PMI Representation & Presentation”, which can be found in the member area of the CAx-IF web sites under “Information on Round33J of Testing”.

Within the PMI Representation area, the following functionalities are in scope of Round 34J:

- PMI Representation
- PMI Graphic Presentation
- Linking of PMI Representation to Presentation

Note: The files shall be in AP242 format, according to the CAx-IF agreement that PMI Representation will be supported solely based on the improved data model available in AP242.

The AP242 schema to be used is at least "AP242 IS MIM Longform EXPRESS schema v1.28", dated February 7, 2014. It can be found in the member area of the CAx-IF web sites under "Information on Round 33J of Testing".

The recommended schema is v1.36 (AP242 IS schema), which can be found under “Information on Round 34J of Testing”, dated May 22, 2014.

2.2.3 Testing Instructions

Two dedicated test models are provided for the testing of PMI Representation, which includes definition of PMI according to the current capabilities. All members participating in this test are asked to add the scope they support to the model as described below.

2.2.3.1 Test Model “1101”

For the testing of PMI Representation, a dedicated test model has been developed by Ed Paff and Bryan Fischer in Round28J. The model is provided in the member area of the CAx-IF homepage, under “Information on Round28J of Testing”:

- A STEP file containing the geometry (*.stp) for re-creation in other CAD systems
- Annex B in the Round28J Test Suite document provides the detailed description of the PMI to be added.

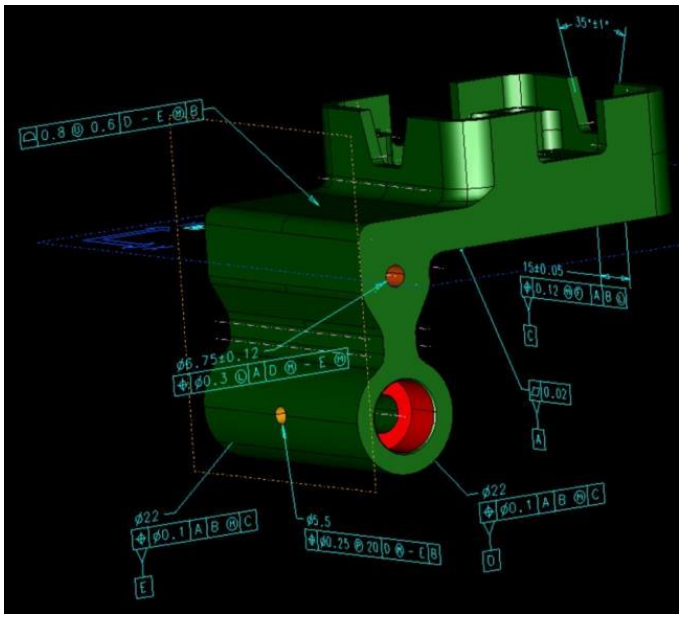


Figure 3: Illustration of the SP3 “1101” Model

2.2.3.2 Test Model “16792”

Another test model testing PMI Representation capabilities is taken from ISO 16792. The model is provided in the member area of the CAx-IF homepage, under "Information on Round31J of Testing", as ZIP file containing:

- A STEP file containing the geometry (*.stp) for re-creation in other CAD systems
- A PDF document (extract from ISO 16792) providing the detailed description of the PMI to be added.

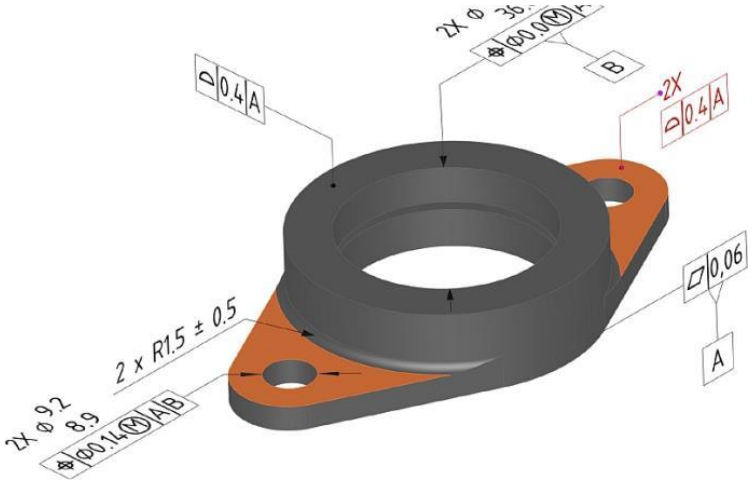


Figure 4: Illustration of the SP3 "16792" Model

2.2.3.3 Test Model “Box”

The so-called “boxy part” is a test model that has been used by NIST for some time, especially for CAD-to-CAM interaction. It is a mid-to-long-term goal to include CAM and CAI/CMM vendors in the CAx-IF to explore downstream application scenarios. Hence, this test model is included in the current round of testing so that those vendors can work with a model they’re already familiar with and that has latest state-of-the-art PMI data included. The details of these planned cross-domain tests have yet to be agreed.

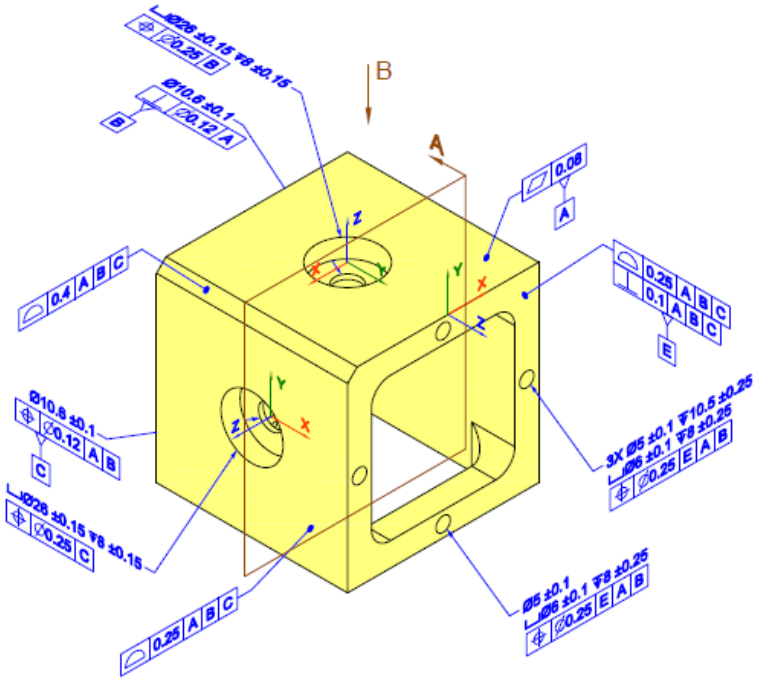


Figure 5: Illustration of the SP3 "Box" Model

The following information is provided for this test model in the CAx-IF member area, under “Information on Round 33J of Testing”:

- The part geometry as STEP file, provided by NIST
- Definition of the PMI to be included/created as PDF file, provided by Bryan Fischer.

2.2.3.4 Test Model Configuration

The following additional functionality should be included in the test files provided for this round of testing, as far as it has been implemented by the CAx-IF participants and is described in the Recommended Practices:

- PMI Representation – the re-usable representation of PMI data should be included in all SP3 models to the extent supported by the native system.
- PMI Graphic Presentation – Many CAD systems require some minimal presentation information to be able to handle the PMI data in a model. There are also use case were both PMI representation and presentation data will be included in the same file. Thus, some form of presentation information shall be included in the SP3 test case as well. The test model configuration for the presentation part is similar to the TP3 test case, see section 2.1. However, Polyline Presentation may also be used here, as in earlier PP3 test cases.
- Linking PMI Representation to Presentation – If a model contains PMI Representation information as well as Presentation data, it is very useful to link the corresponding elements together, so that a Representation element “knows” by which annotation it is being presented in the model. The approach to create this link is described in section 7.3 of the PMI Rec.Pracs. (v3.8).

2.2.3.5 Statistics

For each STEP file exported or imported for the SP3 test case, vendors must submit the corresponding statistics. To do so, go to the [SP3 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec.Pracs. definitions are fulfilled), 'limited support' (meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a STEP file, report the results found after processing the file as described below

Screenshots

If presentation information is contained in the test files, it shall be accompanied by corresponding screenshots. Note that CASEAR allows the addition of multiple screenshots per dataset.

Note that in order to count the GD&T elements for the statistics, per agreement during the R22J Review Meeting, the actual STEP entity types (`datum`, `datum_target`…) shall be considered.

Note that all statistics – native and target – shall be based on the Semantic PMI Representation data only, and not take any presentation into account.

Data Sheet Columns

column name	description
model	The name of the test model, here: 'SP3'
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, enter 'stp'
scope	A short designation of the scope tested in the model. In the case of SP3, recommended values are: ○ Representation ○ Representation + [char.-based / graphic] Presentation ○ Representation + Linked [… / …] Presentation
dimension	The number of dimensions processed
datums	The number of datums processed
datum_targets	The number of datum targets processed
tolerances	The number of tolerances processed
labels	The number of labels processed
pmi_graphic_pres	all/partial/none – whether the graphic PMI annotations included in the file could be processed correctly
pmi_linked_pres_rep	all/partial/none – whether the Semantic PMI Representation elements and (Graphic) PMI Presentation elements were linked correctly together.
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.3 Model B4: Geometric Validation Properties

All information about this test case can also be viewed in CAESAR on its Information page.

2.3.1 Motivation

Geometric Validation Properties are one of the most important and successful capabilities of STEP, which distinguishes it from other neutral exchange formats. The properties allow for the validation of the imported data based on key characteristics calculated by the native system and stored in the STEP file, which are then compared against the results computed for the imported model in the target system.

These key values typically are total volume, total surface area and centroid of the model. Based on recent test experiences and refined use cases, it was agreed to separate these values for the different classes of geometry (solids, independent surfaces, and independent curves) that can be found in a model. “Independent” means that these do not take part in the definition of a higher-class topological element, i.e. an independent curve is not an edge of a surface (it may be part of a wireframe model), and an independent surface is not a face of a solid (it may be part of an open or closed shell).

While the Geometric Validation Properties for Independent Curves have been tested several times now, the values for Independent Surfaces are new and hence shall be tested using a suitable hybrid model.

2.3.2 Approach

For the validation properties, the approaches as described in the "Recommended Practices for Geometric and Assembly Validation Properties", version 4.1, dated June 16, 2014, shall be used, in particular:

- GVP for Solid Geometry, section 4.6
- GVP for Surface Geometry, section 4.7 (new)
- GVP for Curve / Wireframe Geometry, section 4.8
- Bounding Box, section 4.9
- Combining Validation Properties for Efficient Implementation, section 4.10

This document is available in the member area of the CAx-IF homepage, under "Information on Round34J of Testing".

2.3.3 Testing Instructions

The model that will be used in Round 34J has been provided by Audi. It is a model that has been designed for interoperability tests and has been used, among other occasions, in the 2013 JT Application Benchmark facilitated by ProSTEP iViP and VDA.

The model contains:

- The part shape as solid geometry
- The part shape as surface geometry (occupying the same space)
- Additional Wireframe geometry

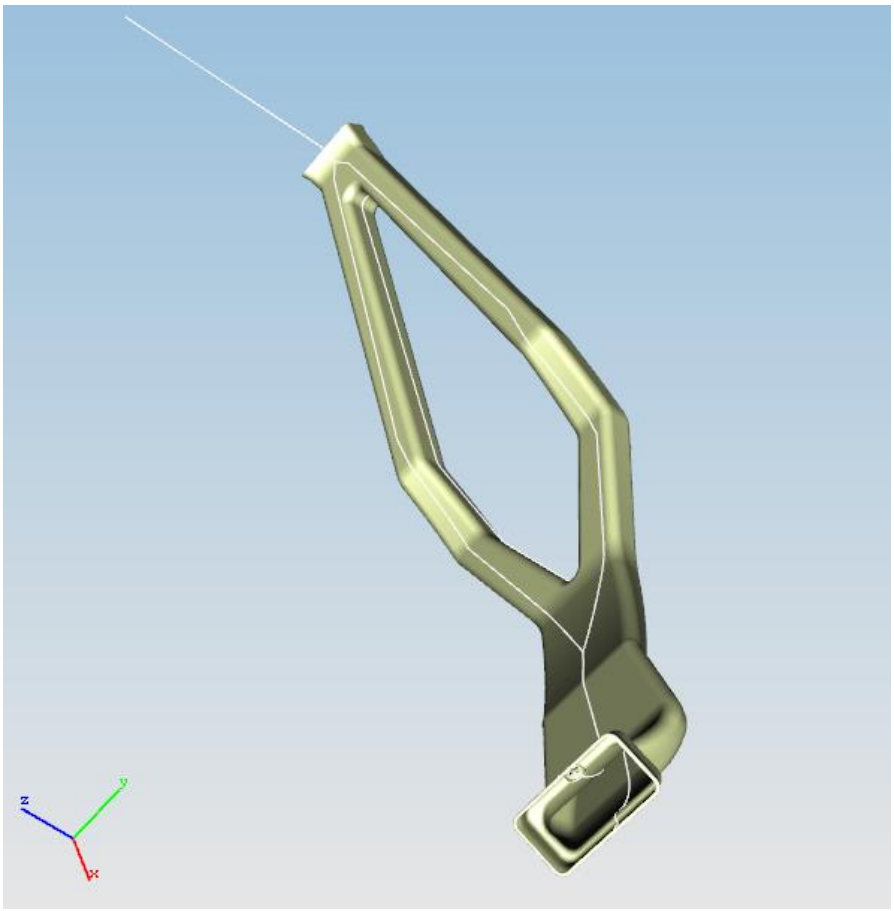


Figure 6: Illustration of the B4 Model

2.3.3.1 Construction of the Model

The model is provided in the following formats:

- CATIA V5 R19 (*.CATPart)
- Creo (*.prt.1)
- NX (*.prt)
- ACIS (*.sat)

The native files are combined into a ZIP archive which is available from the member area of the CAx-IF homepages, under “Information on Round34J of Testing”.

2.3.3.2 Statistics

For each STEP file exported or imported for the B4 test case, vendors must submit the corresponding statistics. To do so, go to the [B4 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec.Pracs. definitions are fulfilled), 'limited support' (meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a STEP file, report the results found after processing the file as described in the table below.

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘B4’
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, enter 'stp'
unit	The unit the model is designed in
volume	Total volume of all solids
validation_volume	Total volume of all solids as received via the validation property capability
valid_vol	pass/fail, is the instantiation of the validation property 'volume' in the STEP file as per the recommended practices for validation properties?
area	Total surface area of all solids
validation_area	Total surface area of all solids in the model, as received via the validation property capability
valid_area	pass/fail, is the instantiation of the validation property 'area' in the STEP file as per the recommended practices for validation properties?
cx	Centroid of the model
cy	
cz	
validation_cx	Centroid of the model (entire assembly) as received via the validation property capability
validation_cy	
validation_cz	
valid_cent	pass/fail, is the instantiation of the validation property 'centroid' in the STEP file as per the recommended practices for validation properties?
surface_area	Total area of all independent surfaces in the model
validation_sfarea	Total area of all independent surfaces in the model, as received via the validation property capability
valid_surface_a	pass/fail, is the instantiation of the validation property 'independent surface area' in the STEP file as per the recommended practices for validation properties?
surface_centroidx	Combined Centroid of all independent surfaces in the model
surface_centroidy	
surface_centroidz	
validation_sfcentroidx	Combined Centroid of all independent surfaces in the model, as received via the validation property capability
validation_sfcentroidy	
validation_sfcentroidz	

valid_surface_c	pass/fail, is the instantiation of the validation property 'independent surface centroid' in the STEP file as per the recommended practices for validation properties?
curve_length	Total length of all (independent) curves in the model
validation_clength	Total length of all independent curves in the model, as received via the validation property capability
valid_curve_l	pass/fail, is the instantiation of the validation property 'curve length' in the STEP file as per the recommended practices for validation properties?
curve_centroidx	Combined Centroid of all independent curves in the model
curve_centroidy	
curve_centroidz	
validation_ccentroidx	Combined Centroid of all independent curves in the model, as received via the validation property capability
validation_ccentroidy	
validation_ccentroidz	
valid_curve_c	pass/fail, is the instantiation of the validation property 'independent curve centroid' in the STEP file as per the recommended practices for validation properties?
bbox_minx	The (min X, min Y, min Z) corner point of the Bounding Box (per GVP RP v3.3 or later)
bbox_miny	
bbox_minz	
bbox_maxx	The (max X, max Y, max Z) corner point of the Bounding Box (per GVP RP v3.3 or later)
bbox_maxy	
bbox_maxz	
valid_bbox	pass/fail, is the instantiation of the validation property 'centroid' in the STEP file as per the recommended practices for validation properties?
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.4 Model TS1: STEP 3D Tessellated Geometry

All information about this test case can also be viewed in CAESAR on its Information page.

2.4.1 Motivation

Recently, a number of scenarios have emerged where the transfer of tessellated geometry within a STEP file is desired by the user community. These include explicit representation of 3D composite part shape, where the semantic definition renders a stack of faces and not a solid, or simplified geometric definition where a fully defined B-Rep model is not needed.

In order to support these uses cases, Part 42 is currently being updated to replace the old “faceted B-Rep” approach with a data model for tessellated geometry that also allows the transfer of open shells and wireframe models.

3D Tessellated geometry in STEP is not intended to compete with visualization formats. It merely provides a simplified geometry definition necessary to support specific scenarios.

Since especially large and complex geometry typically results in large STEP files, they are often compressed using ZIP or a similar mechanism before they are sent to the receiver. Hence, a recommendation has been created to incorporate the compression on export and the inflation on import into the STEP processor, hence creating and handling zipped STEP files with the file extension *.stpZ. This will be tested together with the tessellated geometry. During this process, the STEP file itself is not being changed, it is only being zipped and can be inflated manually using any ZIP tool.

2.4.2 Approach

At least the AP242 IS Review Schema (v1.28) shall be used, since this was the first schema to officially contain the Tessellated Geometry data model. It is available in the member area of the CAx-IF homepage, under "Information on Round33J of Testing".

The recommended schema version is v1.36 (AP242 IS), which is available under “Information on Round 34J of Testing”, dated May 22, 2014.

The general approach for Tessellated Geometry is described in the first draft of the “Recommended Practices for 3D Tessellated Geometry”, Release 0.3, dated February 28, 2014. This file is available in the member area of the CAx-IF homepage, under "Information on Round 33J of Testing".

This release contains in its section 8 also the definition of Validation Properties for Tessellated Geometry.

These Tessellated Validation Properties shall be computed and stored in the STEP file at the part level for each component in the S1 assembly. They shall not be accumulated at assembly-level.

Instead, it was agreed to use the TVP in combination with the Assembly Validation Properties as defined in section 7 of the "Recommended Practices for Geometric and Assembly Validation Properties", version 4.0 (dated November 21, 2013) or later, which is available on the CAx-IF Homepage under "Joint Testing Information" or in the member area respectively.

2.4.3 Testing Instructions

In Round34J, the well-known S1 model (“spaceship”) will be used to test the transfer of 3D Tessellated Geometry in STEP.

2.4.3.1 Construction of the Model

This test case has been used in a number of previous CAx-IF test rounds, therefore the modeling instructions are not repeated here. If a vendor would like to participate in this test case and does not yet have the model, the construction information can be found in the Test Suite for Round 5J, available in the “Joint Testing Information” area of the CAx-IF web site.

Validation properties for 3D Tessellated Geometry shall be added as far as supported.

The STEP Files for the TS1 test case shall be submitted as compressed STEP files (*.stpZ) if supported.

Note that at the Round 32J Review Meeting, it was agreed to change the file extension for compressed STEP files back to “.stpZ” (one dot), after intermittently using “*.stp.Z” (two dots), since “*.stpZ” makes it easier to associate the file extension with the correct application to handle STEP files.

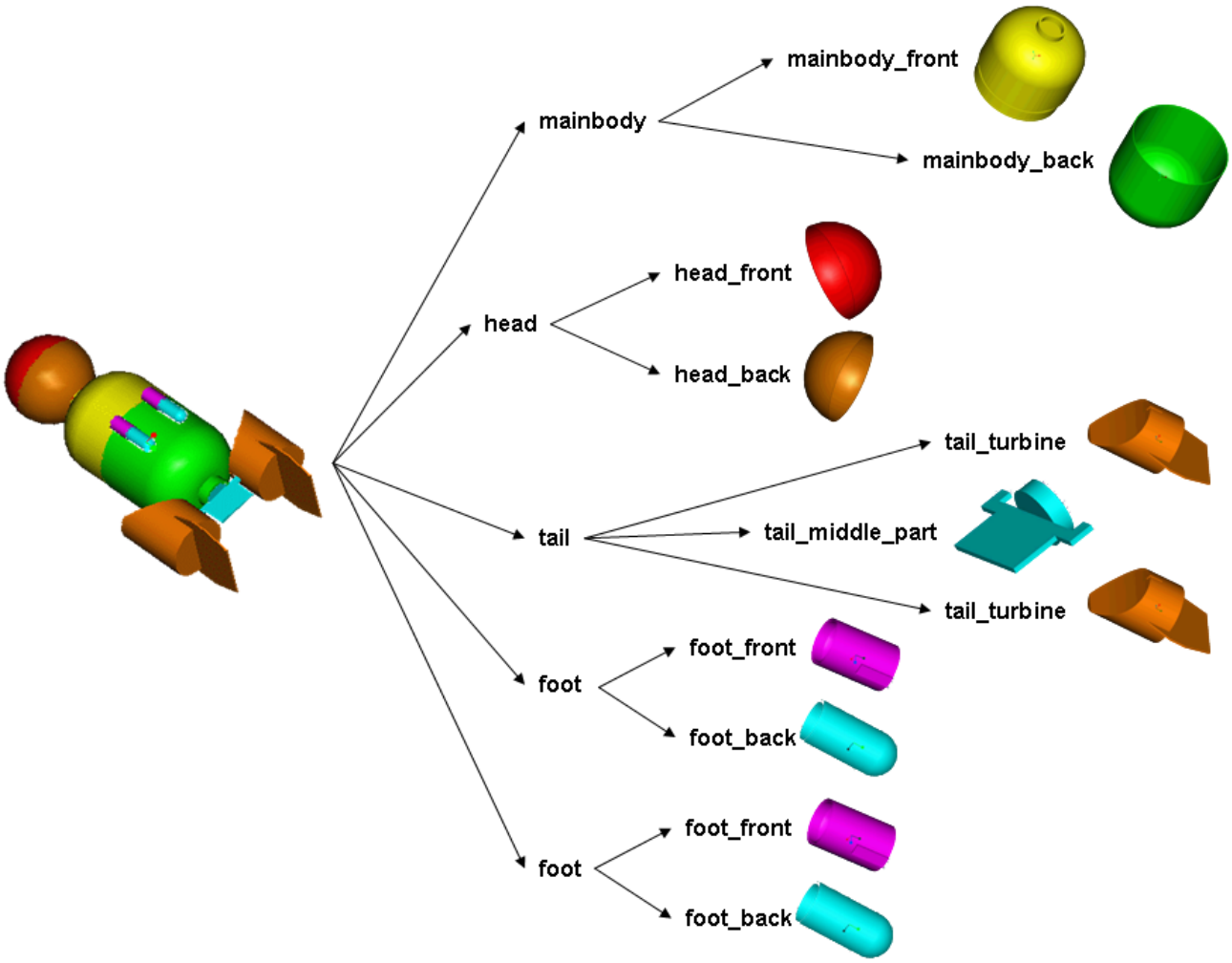


Figure 7: Shape and Structure of the S1 model (spaceship)

2.4.4 Statistics

For each (compressed) STEP file exported or imported for the TS1 test case, vendors must submit the corresponding statistics. To do so, go to the [TS1 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec.Pracs. definitions are fulfilled), 'limited support' (meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a STEP file, report the results found after processing the file as described in the table below.

Data Sheet Columns

column name	description
model	The name of the test model, here: 'TS1'
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, enter 'stp'
match_tess_vp	all/partial/none, whether the Tessellated Validation Properties at part-level match for all, some, or none of the components in the assembly.
valid_tess_vp	pass/fail, is the instantiation of the validation properties for Tessellated Geomtry in the STEP file as per the recommended practices?
children	pass/fail, indicates whether the number of children for each node in the assembly tree matches the AVP value given in the STEP file
valid_child	pass/fail, is the instantiation of the validation property 'number of children' in the STEP file as per the recommended practices for validation properties?
notional_solids	all/partial/none, whether the position of all, some or none of the assembly components in the model could be validated throug the 'notional solids' AVP.
valid_notion	pass/fail, is the instantiation of the validation property 'notional solids' in the STEP file as per the recommended practices for validation properties?
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.5 Model AS1: AP242 XML Assembly Structure

All information about this test case can also be viewed in CAESAR on its Information page.

2.5.1 Motivation

The exchange of assembly structures with external references to geometry files is a long-used concept in the STEP multiverse, which has proven its value and stability in many business use cases. In the CAx-IF context, so far all files of such a package (structure and geometry) were provided as STEP Part 21 files.

Now AP242 provides a Business Object (BO) Model, which is a comprehensive data model with an XML representation, and was designed with the use case of combined use with other formats in mind. The user community hence requests support of this new format for the established use case of assembly data exchange.

2.5.2 Approach

The following schemas shall be used for this test:

- *Updated AP242 IS Business Object Model XML*, dated May 5, 2014 (documentation included in the March 6, 2014, version)
- *AP242 IS Longform Schema* – At least version 1.28, dated February 7, 2014; recommended version 1.36, dated May 22, 2014.

- *Recommended Practices for AP242 Business Object Model XML Assembly Structure*, version 0.x, dated June 18, 2014
- *Recommended Practices for External References*, version 3.1, dated January 20, 2014

All documents can be found in the member area of the CAx-IF homepages under “Information on Round 34J of Testing”; except for the External References Recommended Practices which are listed under Round 33J.

Each set of files (structure + geometry files) shall be provided as a ZIP package containing:

- One Part 21 file (AP203e2, AP214e3 or AP242 IS) for each of the five component parts
- For the assembly structure, either one AP242 BO Model XML file (“all-in-one” approach) or nine AP242 BO Model XML files (one for each level in the assembly structure plus one per component part file; “nested” approach) – see section 13.2 in the Recommended Practices for AP242 BO Model XML Assembly Structure.

2.5.3 Testing Instructions

The test model that will be used for this test is the well-known “AS1” model. Example file sets with external references for Part 21 files can be found in the public CAx-IF file library.

For those vendors who do not have the AS1 model at hand, modelling instructions can be found in the Round8J Test Suite document, which can be found on the “Joint Testing Information” pages of the CAx-IF web sites, dated 09-05-2001.

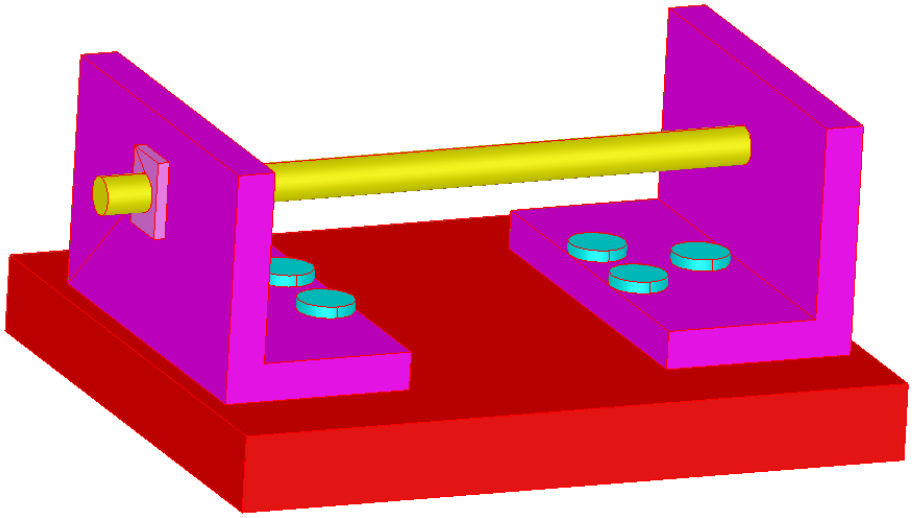


Figure 8: Illustration of the AS1 Model

The aim of this test is to correctly transfer the assembly structure based on AP242 BO Model XML files, using either the “all-in-one” or the “nested” approach.

Since transfer of the AS1 geometry itself can safely be considered stable, there will be no geometry-related statistics. The evaluation will focus on completeness and correctness of the assembly structure (see Figure 9) and the external references.

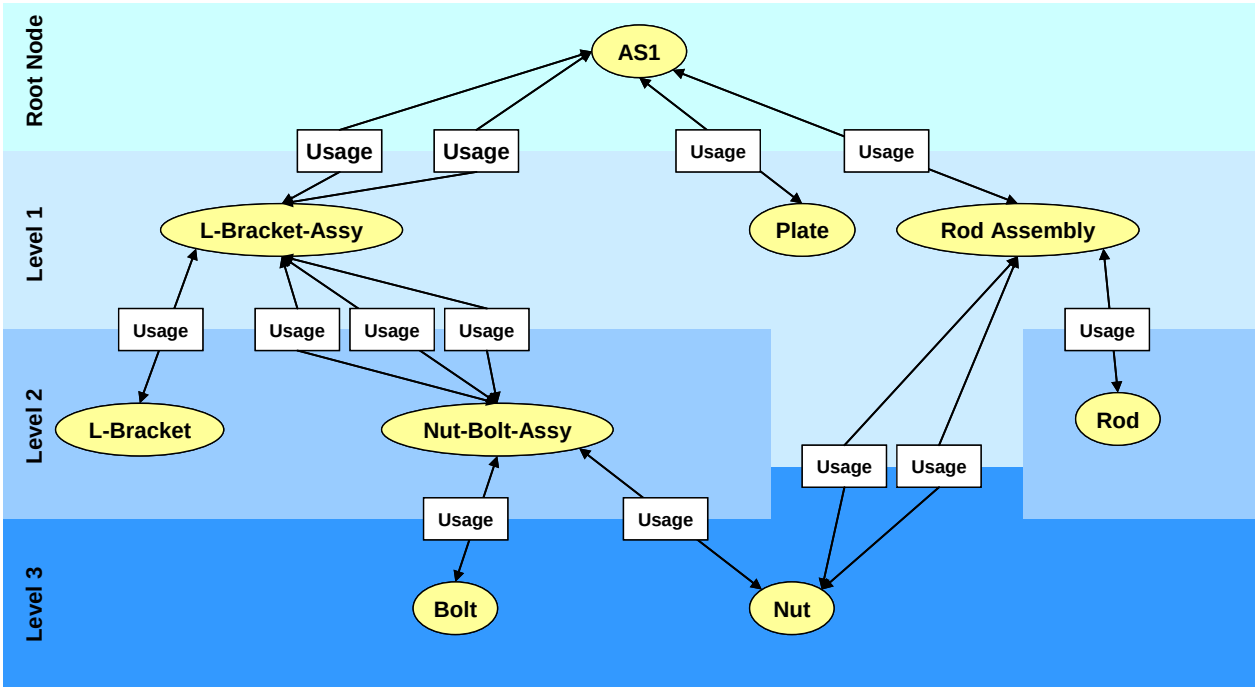


Figure 9: AS1 Assembly Structure

2.5.4 Statistics

For each STEP file exported or imported for the AS1 test case, vendors must submit the corresponding statistics to CAESAR. To do so, go to the [AS1 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec.Pracs. definitions are fulfilled), 'limited support' (meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a STEP file, report the results found after processing the file as described in the table below.

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘AS1’
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, enter 'stp'
fref_found	all/partial/none - indicates if all, some or none of the references to the external files can be found in the assembly structure file(s), and if they are correctly associated with the respective nodes in the assembly structure.

fref_processed	all/partial/none - indicates if all, some or none of the referenced files were be processed correctly to successfully construct the overall model.
assem_struct	pass/fail - if the model structure (assembly tree) was transferred correctly, i.e. no nodes have been added or removed, and all elements are on the correct hierarchical level.
assem_place	all/partial/none - whether the placement of assembly components is correct
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file

2.6 Model CO1: Composite Materials

A test case for composite materials will be added in a later version of this document.

3 Production Models

3.1 PM29

All information about this test case can also be viewed in CAESAR on its Information page.

3.1.1 Motivation

In an attempt to test the STEP processors on real world models, the CAx Implementor Forum will be testing production parts in this round and future rounds of CAx-IF testing. These production models are characteristic for components and assemblies that are encountered in the aerospace and automotive industries. PDES, Inc. and ProSTEP iViP member companies and vendors have supplied these models. As they may contain data about current products of these companies, all native and STEP files related to these models have to be handled confidentially and their use is strictly limited to the CAx-IF activities.

3.1.2 Approach

Testing of Production Models focuses mainly on data quality, not on specific functionalities. Assemblies should therefore be exported as a single STEP file. The file format should be either AP214 (IS or 3rd Ed.), AP203 (2nd Ed.) or AP242 IS (schema version 1.28 or later). In order to support quality validation of the Production Model exchange, all vendors shall include the maximum level of Validation Properties they support, and report them in the statistics. PMI may be included as Polyline Presentation, if defined in the native models.

3.1.3 Testing Instructions

The native models as provided by the user companies should be exported to STEP by all participants who maintain a STEP processor for the respective CAD system. The native models are available on the CAx-IF File Repository in the member area. Once there, browse to the subfolder “Round 34J > Production Models”.

3.1.4 List of available models

As of version 1.0 of this document, no production models are available for testing.

3.1.5 Statistics

For each STEP file exported or imported for the PM29 test case, vendors must submit the corresponding statistics. To do so, go to the [PM29 Data Sheet], and either fill in the web form, or upload a comma-delimited file (.csv) with the data as listed below.

Native Statistics

When exporting a STEP file, report what data importing systems should expect to find. For numeric statistics, enter the respective value or 'na' if not supported. For other statistics, select either 'full support' (i.e. test case and Rec.Pracs. definitions are fulfilled), 'limited support' (meaning the implementation does not meet all criteria and issues may be expected on import), or 'na' if not supported.

Target Statistics

When importing a file, report the results found after processing the file as described below:

Data Sheet Columns

column name	description
model	The name of the test model, here: ‘PM29’
system_n	The system code of the CAD system creating the STEP file
system_t	The system code of the CAD system importing the STEP file. For native stats, enter 'stp'
unit	The unit the model is designed in
volume	Total volume of all solids
validation_volume	Total volume of all solids as received via the validation property capability
valid_vol	pass/fail, is the instantiation of the validation property 'volume' in the STEP file as per the recommended practices for validation properties?
area	Total surface area of all solids
validation_area	Total surface area of all solids (entire assembly), as received via the validation property capability
valid_area	pass/fail, is the instantiation of the validation property 'area' the STEP file as per the recommended practices for validation properties?
cx	Centroid of all solids
cy	
cz	
validation_cx	Centroid of all solids (entire assembly) as received via the validation property capability
validation_cy	
validation_cz	
valid_cent	pass/fail, is the instantiation of the validation property 'centroid' in the STEP file as per the recommended practices for validation properties?
model_size	model_size is the length of the space diagonal of the 3dimensional bounding box enclosing all entities in the model. The result is the Centroid deviation divided by the model_size
dimension	The number of dimensions processed

datums	The number of datums processed
datum_targets	The number of datum targets processed
tolerances	The number of tolerances processed
labels	The number of labels processed
date	The date when the statistics were last updated (will be filled in automatically)
issues	A short statement on issues with the file